15 PLEA

Architecture in (R)Evolution

Bologna
9-11 September
2015

31st International
PLEA Conference

Book of Abstracts

Conference Chairman
Mario Cucinella
Architect, Founder of Building Green Futures, SOS School of Sustainability and Principal MCArchitects

Program Chair
Giulia Pentella
Architect, Executive Director of Building Green Futures, Environmental Design Consultant and Researcher at MCArchitects

Organizing Committee
Mario Cucinella, Giulia Floriani, Giuliana Maggio, Giulia Pentella, Michela Grosso, Alba Fagnani, Patrizia Pizzi

Editorial Team
Mario Cucinella, Giulia Pentella, Alba Fagnani, Luca D'Ambrosio

Hosting Organization
Building Green Futures, non - profit organization
Via Barozzi 3/a, 40126 Bologna, Italy
http://www.buildingreenfutures.org/

Title
PLEA2015 Architecture in (R)Evolution – Book of Abstracts
31st International PLEA Conference – Bologna 9-11 September

First published 2015
ISBN: 978-88-941163-0-4
ISBN: (eBook, Proceedings) 978-88-941163-1-1

Graphic Design Project
Luca D'Ambrosio

Publisher
Ass. Building Green Futures, Bologna

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

ORGANISED BY

Building Green Futures
architecture for sustainable development

PLEA
Sustainable Architecture + Urban Design

MAIN SPONSOR

SOS School of Sustainability — Architecture in Revolution — Post Graduate Education by Mario Cucinella

mario cucinella architects
MCA

SPONSOR

PERMASTEELISA GROUP

iGuzzini

stone s.r.l.

CARRON COSTRUZIONI GENERALI

PAOLO CASTELLI

tecno

ILTEC DESIGN
INNOVATIVE ARCHITECTURE EXPERIENCE

COTABO
IL PRIMO TAXI DI BOLOGNA

elios

PATRONAGE

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

COMUNE DI BOLOGNA

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI ARCHITETTURA

EXPO MILANO 2015
FEEDING THE PLANET
ENERGY FOR LIFE

CNAPPC
CONSIGLIO NAZIONALE
DEGLI ARCHITETTI
PIANIFICATORI
PAESAGGISTI
E CONSERVATORI

LEGAMBIENTE

Symbola
FONDAZIONE PER LE QUALITÀ ITALIANE

PLEA
SUSTAINABLE ARCHITECTURE + URBAN DESIGN

'15 PLEA
Architecture in (R)Evolution
Bologna, 9-11 September

ABOUT

PLEA is an autonomous, non-profit network of individuals sharing expertise in arts, sciences, planning and design of the built environment.

Founded in 1981, PLEA organises international conferences and workshops, expert group meetings and consultancies, scientific and technical publications, architectural competitions and exhibitions.

Since 1982, PLEA has organised international conferences and events across the globe.

PLEA annual conferences are highly ranked events equally attracting academics and practicing architects.

Past conferences were held in United States, Europe, South America, Asia, Africa and Australia.

GOAL AND THEME

It is time to go beyond green architecture, looking at the bigger environmental picture.

Architecture and urban planning need to become again practical tools for building sustainable and resilient lives (before green buildings), in harmony with the ecosystem and local resources.

To pursue this goal, we need to transform our approach to sustainable architecture, starting from the needs people, along with social and economic trends.

Society, Environment, Economy are now in (R)evolution.

- Aging population
- Access to water, improved sanitation facilities, energy inequalities
- Extreme weather events
- Energy expenditures

They represent some of the various challenges affecting communities. It is time for a new Architectural Paradigm, giving to architecture its proper dignity and responsibility to be part of the (R) evolution, through the qualitative and aesthetic contribution of Academics, Researchers, R&D members of industrial companies or professional offices, Practitioners, Startuppers or Postgraduate Students.

The result will be a collection of beautiful and creative (R)solutions to future challenges and will become an expression of the variety characterizing needs, culture, climate, landscape and economy.

Introduction

The PLEA network has been bringing together professionals, academics and students to discuss and share cutting edge knowledge in the field of Sustainable Architecture and Urban Design since 1981. With a special and imminent theme at each occasion, this year's PLEA International Conference focuses on the societal, environmental and economical challenges which are affecting our communities. Organised around five main topics (Right for a Quality Shelter, Post Carbon Cities, Improving Performance, Knowledge Transfer and Resilience-Vulnerability), the conference aims at addressing issues, such as ageing population, access to water, improved sanitation facilities, energy inequalities, extreme weather events and energy expenditures.

Rising weather-related natural disasters, economic instability, complex urban migration fluxes and wide inequalities are making our world more vulnerable and greatly transforming our cities and communities. However, the continuous development of new technologies and the rapid evolution of information exchange systems are affecting the means we share knowledge and the way architects, urban planners and professionals of the built environment are learning and developing their designs, processes and approaches. I hope that the contributions presented here can inspire new and old generations to create resilient and flexible, affordable and fairer design solutions to re-shape our built environment, help solving current problems and improve the quality of our communities.

PLEA 2015 is organised by Building Green Futures and hosted in Bologna, a culturally rich city, plenty of world heritage sites and art master pieces, pleasant urban streets, dynamic warm coloured façades, extensive porticos and inviting plazas. Bologna also provides easy links to Milan, where the EXPO Milan 2015 will be exploring the theme "Feeding the Planet, Energy for Life" at the same occasion.

For the first time PLEA International Conference will endeavour a different format. The various parallel sessions will take place around round tables in one hall with the aim at encouraging discussions among all participants and generating a sense of collective venture. With 292 papers and projects/posters from more than 50 different countries, I am sure the format will be very dynamic and trigger lively debates.

In the name of the PLEA International Network, I would like to thank all those who contributed to the elaboration of this book and its provisions: the Organising Team for their persistent devotion during the conference preparations; the peer reviewers for their dedication and time in reviewing more than 680 abstracts and over 390 full papers, giving critical and constructive comments and securing scientific quality; and all the authors for taking part and for sharing their work and findings without which this book and the 31st PLEA International Conference would not be attainable.

Paula Cadima

President of PLEA
Co-director, Sustainable Environmental Design,
Architectural Association School of Architecture, London, UK.
sed.aaschool.ac.uk

Welcome to Bologna,

City of 44 kilometers of arcades, renowned for its culture and food traditions, expression of an area that has always wanted to show its values through beauty.

Today these values are perfectly represented by the themes of this year's PLEA edition: resilience, participation, care for the environment and respect for citizenship. Bologna has been a model in times of great urban fervency as it has always been able to combine both building and social growth. Housing policies have been defined in a logic of social mixed uses and not based on exclusion, as happened to the suburbs of many cities.
Those policies have been forward-looking and show how a good vision of the near future can have a positive impact on citizens.

Today we are facing a change in paradigms and new roads. Ernest Hemingway said: "We have to get used to the idea that the most important crossroads in life have no signposting." Tackling these important crossroads in life, PLEA becomes that signal, indicating which way to go to reach a future of even closer change.
As people experience evolving needs and face new economic and environmental challenges, architecture is called upon to provide appropriate answers in harmony with the environment and the cultural context.
However, when it comes to sustainability, there is a noticeable difference between ambitions and results. To bridge this gap, we must redraw the professional figure of the architect through new tools and smart learning strategies. This is the meaning and evolution of PLEA network: increasing integration between research and professional world. Nowadays, our profession requires new means and consciousness as we are discovering a new dimension of professional development and knowledge specialization: more visionary, more humanistic, allowing us to give research a new meaning. In the light of these upcoming challenges, there is a strong need for future.

This year's PLEA will be structured in a new format, with 12 tables representing the major themes of the program. Around these tables, a shared discussion will be held with the help of the Chairmen, together with research works and posters, looking at debates as moments of reflection and exchange among participants.
I would like to thank all the Building Green Future and MCA staff for the commitment and dedication to the organization of this event, the Chairmen of tables, Professor Federico Butera, to whom we have entrusted the task of summarizing the results of the work, President Paula Cadima, the PLEA Board, the Keynote Speakers and all of you gladly participating in this event. Last but not least, I would like to thank our sponsors for giving vital contribution to the conference. At the end of the three days, our goal is to write a short paper called "Bologna PLEA Chart", in order to highlight the road to take and create a widely shared knowledge tool.

A warm greeting to all of you,

Mario Cucinella

PLEA2015 Conference Chairman, Architect,
Founder of Building Green Futures, SOS School of Sustainability
and Principal MCArchitects
http://www.buildingreenfutures.org/
http://www.schoolofsustainability.it/
http://www.mcarchitects.it/

Architecture in (R)Evolution

The title "Architecture in (R)Evolution" aims to convey several messages using few words.

It invites us to observe results obtained so far through low energy architectural design and encourages us to take a step forward ("evolution") towards a future balance between man and nature, reversing the approach to sustainable design ("revolution").

The choice of a holistic and forward-looking architecture that goes beyond its natural field to embrace sociological, economic and ecological issues is essential to understand that energy is just one of the issues communities have to face. These interconnected problems need to be analyzed together to be solved effectively.

In order to achieve this result, we should have the courage to start considering people's needs and generate wealth through low environmental impact solutions. Bioclimatic architecture is not only a goal, but a real mean to build a society with a safe environment and social justice. Focus moves from the reduction of energy and environmental impact of buildings towards self-sufficient solutions for communities, to decrease their vulnerability at different scales (country, community, family, individual) while increasing their resilience, in the frame of a collective development vision. The IPCC identifies the key to reducing the ecological footprint of human activities in the ability to change lifestyles, rather than in top down environmental policies. In this perspective, a building and its neighborhood will be sustainable when they are able to create sustainable lifestyles.

Through the three-day conference of PLEA2015, we will realize that, on the other side of architecture, climate and people's habits are changing. We will walk tiptoed through the streets to denounce the unsustainable environmental impact that is still tied to the construction industry. We will go to the borders of the city to realize there may be no more borders at all, according to the growth of the urban population. Along this path we will visit the districts and tell people's lives and desires. Suddenly we will find ourselves walking on our hands, watching the world from a different point of view. Thanks to this new awareness, we will realize how urgent starting back from the existing is, how to breathe new life and go beyond a fleeting consumerist urgency. Moreover, we will learn how important it is to embrace a new cultural model, which focuses on individuals, leading to an inclusive human development.

Finally, we will be able to abandon all superstructures and be free again to design resilient cities that can be suitable for a child, a young man and an elderly, while respecting the environment.

Giulia Pentella

PLEA2015 Program Chair, Executive Director of Building Green Futures, Architect and Researcher at MCArchitects Srl, Environmental Design Consultant, Lecturer of sustainable architecture

MARIO CUCINELLA

Chairman of PLEA 2015

Director, MCArchitects

Mario Cucinella is the founder of Mario Cucinella Architects (MCA), an architecture firm based in Bologna, where he leads an international team of architects and engineers.
With more than 20 years of professional practice, MCA has developed an extensive experience in architectural design and urban planning with particular attention to energy issues and environmental impact of buildings.

Mario Cucinella's work has been internationally recognised.
Mario Cucinella was born in Palermo (Italy) in 1960. In 1987 he received an advanced degree (Laurea) in Architecture from the University of Genoa, where he was mentored by Giancarlo De Carlo. From 1987 to 1992 he worked as project manager by Renzo Piano in Genoa and in Paris. From 1998 to 2006 he taught at the Faculty of Architecture in Ferrara (Italy). Since 2004 he is 'Honorary Professor' at the University of Nottingham (England). In 2013 he is 'Guest Professor' in Emerging Technologies at the Faculty of Architecture at the Technische Universitat in Munich and in 2014 he is "Guest Professor" at Faculty of Architecture Federico II, Naples. Mario Cucinella is currently Director at PLEA (Passive and Low Energy Architecture) and he regularly holds conferences in Italy and abroad.

In 2014 he worked as a tutor with Renzo Piano to the project G124 for the recovery of the suburbs in Italy.
In January 2012, he founded Building Green Futures a non-profit organization that promotes sustainable development through green architecture and urban regeneration. The goal is to create built environments that incorporate clean technologies and local knowledge for better living conditions and sustainable access to natural resources in developing and least developed countries.
The flagship project of Building Green Futures is "Kuwait City School" for Gaza, developed in partnership with UNRWA. Since 2014 he has started in Bologna (Italy) S.O.S. - School of Sustainability, a school focused on training new professionals in the field of sustainability.

GIULIA PENTELLA

Program Chair of PLEA 2015

Architect and Researcher at MCArchitects Srl

Architect - Honours graduate in 2007 at the University of Rome La Sapienza with a thesis awarded by the National Competition in Sustainable Architecture Raffaella Alibrandi Prize, 2009.

She first joined the Reinberg ZT GmbH architecture studio in Vienna, then worked in Italy for Fontana Atelier. In 2009 she moved to Bologna, joining the R&D team in Mario Cucinella Architects as Sustainability Consultant.

She has been invited as a speaker to many national and international conferences, juries and postgraduate courses. As part of the "InCreaSe" research team, she has written several articles for Franco Angeli Publishing.

Her research focuses on a more people-centered environmental architecture, combining sustainability with universal and inclusive design principles.

In 2013 she became the Executive Director of Building Green Futures. In this field she produced the Guidelines Sustainable Solutions for Expo Milano 2015 and she worked as Head Architect of the Green School project in Gaza, in partnership with UNRWA, also giving her support for capacity building activities.

ANTONIO NAVARRA

Keynote Speaker

President of the CMCC
Centro Euro-Mediterraneo
per i Cambiamenti Climatici

Antonio Navarra (Naples, 1956) has graduated in Physics in Bologna on 1980 and has come back to Italy on 1986, after getting a Ph.D. at the Geophysical Fluid Dynamics Laboratory of the Princeton University.

He is Dirigente di Ricerca at the National Institute of Geophysics and Volcanology, where he carries out his activity in the field of the climate simulation with general circulation numerical models. He is now President of the CMCC – Centro Euro-Mediterraneo per i Cambiamenti Climatici, an interdisciplinary center for climate change studies and their impacts (www.cmcc.it).

The scientific interests of Dr. Navarra focus on the investigation of the dynamical mechanisms which control climate on the global scale, particularly regarding the climate variability of the atmosphere-ocean system on interannual, decadal and centennial scales using statistical methods, numerical simulations and simplified models.

Dr. Navarra is also teaching a course at the Università di Venezia, in the context of the Dottorato di Ricerca in Scienza e Gestione dei Cambiamenti Climatici. He is the author of several books and articles of general interest and contributes to national newspapers. He has written: El Niño. Realtà e leggende del fenomeno climatico del secolo (Avverbi, 1997), Le previsioni del tempo (Il Saggiatore, 1996) and, with Andrea Pinchera, Il Clima, (Laterza, 2000).

He has written Le previsioni del tempo (Il Saggiatore, 1996), with Andrea Pinchera, Il Clima, (Laterza, 2000), and recently, with Emanuela Guidoboni and Enzo Boschi, Nella spirale del clima, Bononia University Press, 2010.

RAB BENNETTS

Keynote Speaker

Director, Bennetts Associates

Rab and Denise Bennetts met at architecture school in Edinburgh, graduating together in 1977.

After ten years with different architects in London, they formed Bennetts Associates in 1987. The practice now has around 90 people, with a main studio in London and a smaller office in Edinburgh.

The practice's workload covers a wide range of sectors and scales, from public buildings, universities and transport infrastructure to commercial offices, hotels and corporate headquarters. Notable award-winning projects include the Royal Shakespeare Theatre in Stratford-upon-Avon, the Jubilee Library in Brighton, the £200m New Street Square development in the City of London's financial district, Edinburgh University's Informatics Forum and Camden Council's community building at King's Cross in London. Current work includes two further projects at the huge King's Cross regeneration project, a major project for Jaguar Land Rover near Warwick, a student centre at Cambridge University and theatres in Glasgow, Chester and London.

Although Rab Bennetts leads the practice's design direction it operates a collaborative working method with all architects empowered to play a full part in the design process. Sustainability has been at the heart of the firm's projects for more than 20 years and the practice has contributed extensively to research and dissemination. Rab helped to form the UK Green Building Council in 2007 and sits on its Board. He is also a Trustee of the UK Design Council and a Board member at Sadler's Wells Theatre. He was awarded OBE for services to architecture by the Queen in 2003.

To date Bennetts Associates has won more than 130 awards and has been shortlisted for the RIBA Stirling Prize three times.

FILIPPO GRANDI

Keynote Speaker

Humanitarian, Former UNRWA Commissioner-General

Filippo Grandi, born in Italy in 1957, has been engaged in international cooperation for over 30 years, 26 of which as a United Nations official. His focus has been prevalently refugee and humanitarian work, addressing the human consequences of several major conflicts of the last three decades, from several countries in Africa (especially Sudan and the Great Lakes region) to South-East Asia and the broader Middle East.

From 1997 to 2001 he worked as Special Assistant and then Chief of Staff of the UN High Commissioner for Refugees; from 2001 to 2005 he worked in Afghanistan, first with UNHCR and then with the UN political mission as Deputy Special Representative of the UN Secretary-General; his latest assignments, from 2005 till earlier this year, were with UNRWA, the UN Agency for Palestine refugees - first as Deputy Commissioner-General and then Commissioner-General of the organization for four years. He is now on special leave from the United Nations.

Filippo graduated in modern history from the State University in Milan in 1981.

He has an honorary doctorate from the University of Coventry and is currently an IFI Senior Research Fellow in UN and International Affairs at the American University in Beirut, and an Honorary Associate of the Department of International Development of the University of Oxford.

ANDREAS OTTO KIPAR

Keynote Speaker

Landscape Architect

International architect and landscape designer, Andreas Kipar works in the field of planning and landscape design, with emphasis on green, historical and environmental recovery in Italy and abroad.

He has practiced in Germany since 1985, when he opened KLA_ kiparlandschaftsarchitekten with the headquarters in Duisburg. In 1990, he founded the design company LAND (Landscape Architecture Nature Development) along with the Agronomist Dr. Giovanni Sala in Milan.

He is a member of the German Association of Landscape Architects (BDLA), of the Italian Association of Landscape Architects (AIAPP) and of the German Association for Garden Design and Landscape Architecture (DGGL).

Andreas Kipar collaborated from 1985 to 2000 to the creation of the North Park (600ha), the Park Rubattino (Ex Maserati), the Public Park (Ex Industrial Area OM), the Portello Park (Ex Alfa Romeo) in Milan, Parco Krupp in Essen, the "Spina 3" Park in Turin, "Parco delle Sabine" in Rome and all the outside areas in Porta Nuova, Milan.

He teaches in various universities in Italy and abroad, and is currently a professor at the Milan Polytechnic, where he teaches Public Space Design. In 1990 he won the public award of INU-Lombardy (Italian Institute for Urban planning), in 2002 the European award for landscape architecture of ELCA – European Landscape Contractors Association, in 2006 the "North Renania Westfalia landscape Architecture Award" LandschaftsArchitektur-Preis NRW 2006 and in 2008 he won the Special landscape prize of Sardinia.

WWW.LANDSRL.COM
WWW.KIPARLANDSCHAFTSARCHITEKTEN.DE
WWW.GREENCITY-ITALIA.ORG
FACEBOOK - LAND SRL

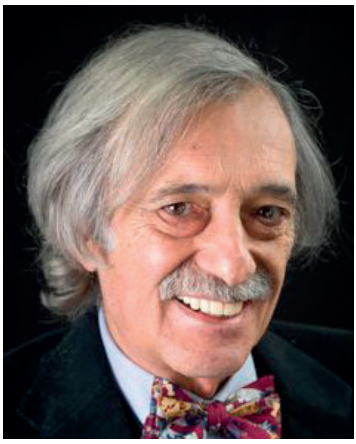
CARLO RATTI

Keynote Speaker

Director, MIT Senseable City Lab
Founding Partner, Carlo Ratti Associati

An architect and engineer by training, Carlo Ratti practices in Italy and teaches at the Massachusetts Institute of Technology, where he directs the Senseable City Lab. He graduated in engineering from the Politecnico di Torino and the École Nationale des Ponts et Chaussées in Paris, and later earned his MPhil and PhD in architecture at the University of Cambridge, UK. Carlo holds several patents and has co-authored over 250 publications. As well as being a regular contributor to the architecture magazine Domus and the Italian newspaper Il Sole 24 Ore, he has written for the BBC, La Stampa, Scientific American and The New York Times. His work has been exhibited worldwide at venues such as the Venice Biennale, the Design Museum in Barcelona, the Science Museum in London, GAFTA in San Francisco and the Museum of Modern Art in New York.
Carlo has been featured in Esquire magazine's '2008 Best & Brightest' list and in Thames & Hudson's selection of '60 innovators' shaping our creative future. In 2010, Blueprint magazine included him as one of the '25 People Who Will Change the World of Design', Forbes listed him as one of the 'Names You Need To Know' in 2011 and Fast Company named him as one of the '50 Most Influential Designers in America'. He was also featured in Wired magazine's 'Smart List 2012: 50 people who will change the world'. His 'Digital Water Pavilion' at the 2008 World Expo was hailed by TIME magazine as one of the 'Best Inventions of the Year'. In 2011, Carlo was awarded the Renzo Piano Foundation prize for 'New Talents in Architecture'. Carlo has been a presenter at TED (2011), program director at the Strelka Institute for Media, Architecture and Design in Moscow, curator of the '2012 BMW Guggenheim Pavilion' in Berlin, and was named 'Inaugural Innovator in Residence' by the Queensland Government. The Italian Minister of Culture also named Carlo as a member of the Italian Design Council - an advisory board to the Italian Government that includes 25 leaders of design in Italy. He is currently serving as a member of the World Economic Forum 'Global Agenda Council for Urban Management' and is a curator for the 'Future Food District' pavilion for 2015 World Expo in Milan.

For further information on Carlo's projects, please visit www.carloratti.com and senseable.mit.edu



FEDERICO M. BUTERA

Supervisor of Chairmen's Board

Federico M. Butera, formerly professor of Environmental Applied Physics at the Politecnico di Milano, is UN-Habitat consultant for the development of handbooks on sustainable building and community design in tropical climates and for the design and implementation of training courses on the same subjects in East Africa.

For more than 40 years he has been actively concerned in the field of solar energy applications, low energy architecture and sustainable urban development, pioneering the introduction of the topic "sustainable building design" in the architecture students' education.

He has been involved in many research tasks of the IEA Implementing Agreement "Energy Conservation in Buildings and Community Systems" and "Solar Heating and Cooling", as well as in several EC research programs and in UN and World Bank development projects dealing with renewables and efficient use of energy at building and community scale.

Besides his wide scientific production he is also author of books, articles and videos on energy issues for non-specialised audiences.

In the last years he has been involved in the design of low and zero energy buildings and communities in Italy, China, Hungary and Niger.

He is author of more than 200 scientific publications and 11 books.

He was awarded "Pioneer for Contributions in renewable Energy" by the World Renewable Energy Network in 1998 and, for his "outstanding service to the utilization and promotion of Renewable Energies and Sustainable Architecture", by Eurosolar in 2004.

LOCAL ORGANISING COMMITTEE

Mario Cucinella
PLEA2015 Conference Chairman, Architect, Founder of Building Green Futures, SOS School of Sustainability and Principal MCArchitects
http://www.buildingreenfutures.org/
http://www.schoolofsustainability.it/
http://www.mcarchitects.it/

Giulia Floriani
PLEA2015 Logistics, Finance and Public Relations Chair, Lawyer, Chief Executive Officer MCArchitects Srl and Co-founder of Building Green Futures

Giulia Pentella
PLEA2015 Program Chair, Executive Director of Building Green Futures, Architect and Researcher at MCArchitects Srl, Environmental Design Consultant, Lecturer of sustainable architecture

Giuliana Maggio
PLEA2015 Logistics and Public Relations, Engineer at MCArchitects Srl

Michela Grosso
PLEA2015 Publications Chair, Graphic and Communication Referent Person at MCArchitects Srl and Building Green Futures

Alba Fagnani
PLEA2015 Project Management

Patrizia Pizzi
PLEA2015 Conference Administrative Office

Luca D'Ambrosio
PLEA2015 Graphic Design Project
www.lucadambrosio.com

Ferrari Computer
PLEA2015 Technical Advisor, Web Developer
http://www.ferraricomputer.it/

Carlobruno&associati
PLEA2015 Press Office
http://carlobrunoassociati.com/

Valeria Corbetta
PLEA2015 Social Media Manager

Zup
PLEA2015 Photo and Video Service
http://www.zup.it/

Bologna Welcome
Tourist Information Service and Conference Venue Manager
http://www.bolognawelcome.com/

INTERNATIONAL ADVISORY COMMITTEE

Paula Cadima
President of PLEA. Co-director, Sustainable Environmental Design, Architectural Association School of Architecture, London, UK.
sed.aaschool.ac.uk

Mario Cucinella
PLEA2015 Conference Chairman, Architect, Founder of Building Green Futures, SOS School of Sustainability and Principal MCArchitects
http://www.buildingreenfutures.org/
http://www.schoolofsustainability.it/
http://www.mcarchitects.it/

Denise Duarte
Senior Lecturer, University of Sao Paulo, Brazil.
http://lattes.cnpq.br/5139970233939681

Brian Ford
Emeritus Professor University of Nottingham, UK.
www.naturalcooling.co.uk

Edward Ng
Yao Ling Sun Professor of Architecture of The Chinese University of Hong Kong.
www.edwardng.com

Heide Schuster
Prof. Dr.-Ing, Professor for Energy Design - Owner of BLAUSTUDIO.
www.blaustudio.de
www.fra-uas.de

Simos Yannas
PLEA founding member and permanent Secretary. Director, Sustainable Environmental Design, Architectural Association School of Architecture, London, UK.
sed.aaschool.ac.uk

Giulia Pentella
PLEA2015 Program Chair, Executive Director of Building Green Futures, Architect and Researcher at MCArchitects Srl, Environmental Design Consultant, Lecturer of sustainable architecture

TECHNICAL COMMITTEE

Rajendra Adhikari
Associate Professor in Building Physics at Dept. Architecture, Built Environment and Construction Engineering, Politecnico di Milano.
http://www.polimi.it/en/english-version/

Shabbir Ahmed
PhD (AA), Professor of Architecture, Bangladesh University of Engineering & Technology. PLEA Associate.
http://www.buet.ac.bd/arch/

Hana Alamuddin
R.I.B.A , SmarchS (M.I.T) LEED AP ND . Principal at Almimariya Architects and Designers. Senior lecturer at the American University of Beirut (AUB).
www.almimariya.com

Fernanda Alonge
Architect and Urban Planner, Master's Graduate Program in Architecture and Urbanism at the Universidade Estadual Paulista "Julio de Mesquita Filho" - Unesp Bauru.
http://buscatextual.cnpq.br/buscatextual/visualizacv.do?id=K4303457Y6

Sergio Altomonte
Associate Professor at Nottingham University.
www.nottingham.ac.uk/engineering/people/sergio.altomonte

Fabrizio Amadei
Environmental architect, construction manager.

Marilyne Andersen
Professor and Dean at EPFL, daylighting expert.
http://people.epfl.ch/marilyne.andersen

Alexandra Andone
PRP Architects London, AA E+E MArch in Sustainable Environmental Design

Massimo Angrilli
Lecturer/researcher of Urbanism, at University of Chieti-Pescara, dept. of Architecture. Member of the teaching body of the Phd "Earth Systems and built environment".

Ernesto Antonini
Professor at University of Bologna, Dept. of Architecture

Rigoberto Arambula
Architect, Msc, Phd candidate/Free University of Bozen-Bolzano.

Krishan Arvind
Prof. Dr., Former Dean SPA, Architect-Structural Engineer in Professional practice, Research and Teaching.

Niccolò Aste
Full professor in Building physics and indoor environment at the Polytechnic University of Milan

Shady Attia
PhD, LEED®AP, Assistant Professor and Head of the Sustainable Buildings Design Lab (SBD) at Liège University.
www.sbd.ulg.ac.be
www.shadyattia.net

Adolfo Baratta
Associate Professor in Technology for Architecture, Roma Tre University. Research fields: Arch. Technology and Environment, Production and Construction.

Enrico Baschieri
Architect, co-founder of Ecodesign, an Engineering & Environmental Design company, that provides dynamic simulation of buildings and systems and designs and build Net Zero Energy Buildings and Permaculture Gardens
www.ecodesign.it

Massimo Bastiani
Architect, Senior Researcher for Ecoazioni, member of the Interuniversity Research Center for Sustainable Development (CIRPS) and of the European Photovoltaic Technology Platform "Building Integration Photovoltaic (BIPV)"
www.ecoazioni.it

Alessio Battistella
Architect Ph.D, Arcò chairman, member of Competence Board of SOS-School of Sustainability.
www.ar-co.org

Amar Bennadji
Lecturer of Architecture at The Robert Gordon univerdity in Scotland, UK.
https://www.rgu.ac.uk/dmstaff/bennadji-amar

Andrea Boeri
Full Professor in Technology for Architecture, Bologna University.
http://www.unibo.it/SitoWebDocente/default.aspx?UPN=andrea.boeri%40unibo.it

Fabrizio Bonatti
Architect and researcher at Mario Cucinella Architects, Parametric Design Consultant, lecturer of tools for design optimization and digital fabrication.
www.mcarchitects.it

Simon Paul Borg
Lecturer/Researcher at the University of Malta.
www.um.edu.mt/profile/simonpborg

Gian Luca Brunetti
Architect PhD, Lecturer of Building Technology at the Polytechnic of Milan.

Alberto Bruno
Architect and researcher at Mario Cucinella Architects and Building Green Futures, Director of School of Sustainability, Environmental Design Consultant, lecturer of sustainable architecture.
http://www.mcarchitects.it/
http://www.schoolofsustainability.it/

Maddalena Buffoli
Arch., Assistant Professor at the School of Architecture of Politecnico di Milano, specialized on Urban Health, Environmental hygiene, Sustainable policy and technology in buildings and Environmental Impact Analysis.

Vincent M. Buhagiar
Professsor, B.E.& A.(Hons.), M.Sc(Lond.), Ph.D.(Wales), Perit. Head Department of Environmental Design, Faculty for the Built Environment, University of Malta
http://www.um.edu.mt

Waldo Bustamante
Professor at the School of Architecture. P.Universidad Católica de Chile. Researcher of CEDEUS (Center for Sustainable Urban Development).
www.arquitectura.uc.cl
www.cedeus.cl/investigadores/

Paula Cadima
President of PLEA. Co-director, Sustainable Environmental Design, Architectural Association School of Architecture, London, UK.
sed.aaschool.ac.uk

Laura Calcagnini
Post doc Sapienza Univ of Rome,Ph.D Energy Science.

Eliana Cangelli
Professor and Director of PhD Program in Environmental Design, Sapienza University of Rome.

Paola Caputo
Assistant Professor in building physics at Dep. Architecture, Built Environment and Costruction Engineering of Politecnico di Milano
http://www.abc.polimi.it/persone/personale-docente/

Carmine Caridà
Structural engineer

Paolo Cascone
AA-MA / PhD- Eng., AA trained architect founder of CodesignLab and Adjunct Professor in Building Technology at the Milan Polytechnic.
www.codesignlab.org

Roberta Cocci Grifoni
Physicist, PhD, Assistant Professor in Environmental Applied Physics at School of Architecture and Design, University of Camerino, Italy.
http://d7.unicam.it/sad/

Raphaël Compagnon
Dr. physicist EPFL.

Mario Cucinella
PLEA2015 Conference Chairman, Architect, Founder of Building Green Futures, SOS School of Sustainability and Principal MCArchitects
http://www.buildingreenfutures.org/
http://www.schoolofsustainability.it/
http://www.mcarchitects.it/

Marwa Dabaieh
PhD, post-doc researcher at Lund University, Sweden
http://www.bv.lth.se/kontakt/personal/

Pierluigi De Berardinis
Building engineer, Professor in Building technology and Production techniques of building materials, University of L'Aquila

Francesca De Filippi
Architect, PhD; Lecturer and adjunct professor in Architectural Technology, Department DAD (Architecture and Design); Director of CRD-PVS (Research and Documentation Centre in Technology, Architecture and City in the Global South) - Politecnico di Torino

Marco Dell'Agli
Senior architect at MCArchitects Srl

Claude MH Demers
Professor, École d'Architecture, Université Laval, Québec.
GRAP Groupe de recherche en ambiances physiques / Environmental controls in architecture.
http://www.grap.arc.ulaval.ca

Khaled Dewidar
Professor of Architecture, PhD. University of Pennsylvania, Vice Dean for Teaching and Learning, The British University in Egypt.
http://www.bue.edu.eg/index.php/engineering-staff/faculty-leadership-eng-staff/khaled-dewidar

Giuseppe Dibari
Head of Real Estate and Director of Sustainability group at Deerns Italia (Milan office). UK and Italian chartered engineer, CIBSE member, US and Italian Green Building Council member, LEED AP BD+C.
www.deerns.it

Emanuele Dionigi
Architect at Mario Cucinella Architects, teaching assistant at the University of Bologna.

Denise Duarte
Senior Lecturer, University of Sao Paulo, Brazil.
http://lattes.cnpq.br/5139970233939681

John Martin Evans
Consultant Professor, University of Buenos Aires.

Arnaud Evrard
Dr Ir Arch, Research Fellow and invited lecturer at Université catholique de Louvain. PLEA associate.
www-climat.arch.ucl.ac.be

Kristian Fabbri
Architect, Energy Efficiency Consultant, Adj.Prof. Environmental Physics Technique.
www.kristianfabbri.com

Enrico Fabrizio
Researcher and Assistant Professor at University of Turin

António Feio
Sustainable architect, tourism buildings researcher.
http://lnkd.in/dkxR-n9

Brian Ford
Emeritus Professor University of Nottingham, UK.
www.naturalcooling.co.uk

Andrea Fornasiero
Engineer and researcher at Manens-Tifs SpA, President of Standard Committee at GBC Italia.

Cristina Garavelli
Architect, lecturer of environmental design, member of GBC Italy.

Susanne Gampfer
Engineer, Professor at Faculty of Architecture and Civil Engineering, University of Applied Sciences Augsburg

Jose Roberto Garcia-Chavez
Ph. D. Professor-Researcher of the Graduate Programme on Bioclimatic Architecture at University of Mexico. PLEA Associate.

Jacopo Gaspari
Ph. D., Researcher - Technology for Architecture Professor of Materials and Construction Technologies DA - Department of Architecture ALMA MATER STUDIORUM - University of Bologna.

Philipp Geyer
Professor in architectural engineering at KU Leuven with a focus on computer methods and models for energy efficient and sustainable buildings design. www.kuleuven.be/wieiswie/en/person/00096275

Rajat Gupta
Professor of Sustainable Architecture and Climate Change
Director of Oxford Institute for Sustainable Development (OISD)
Director of OISD: Low Carbon Building Group

Annette Hafner
Professor for resource efficient building at Ruhr University Bochum, Germany and also an architect. www.ruhr-uni-bochum.de/reb/index.html.de

Justin CK HO
PhD, Research Associate at The Institute of Environment, Energy and Sustainability, The Chinese University of Hong, with a focus on Sustainable Urban and Environmental Design, Daylighting and Urban Climate.

Muhannad Haj Hussein
Assistant professor at NNU in Palestine. http://staff.najah.edu/mhajhussein

Phil Jones
Professor in Architectural Science at Welsh School of Architecture, Low Carbon Research Institute (LCRI) chairman

Daniel HII Jun Chung
PhD Building candidate, National Uni. of Singapore http://www.bdg.nus.edu.sg/files/BRSNetizen/CV%20-%20Daniel%20Hii%20Jun%20Chung.pdf

Mohammd Arif Kamal
Dr., Architect, Adjunct Faculty, Shushant School of Art and Architecture, Ansal University, India.

Aleš Krainer
Prof. Arch. Dr. Scient. Counc. University of Ljubljana, Faculty of Civil Engineering, Slovenia.

Roland Krippner
Dr.-Ing., Architect, Professor for construction and technology at Nuremberg Institute of Technology, Faculty of Architecture, Germany www.th-nuernberg.de/ar/

Roberta Consentino Kronka Mülfarth
PhD, Professor at FAUUSP since 2006 with a focus on Environmental Comfort area, Environmental Performance, Sustainability and Ergonomics. Technical advisor for the Superintendent of Environmental Management at USP.

Pablo La Roche
Professor of Architecture at Cal Poly Pomona University and Sustainable Design Leader at RTKL Associates. http://www.cpp.edu/~pmlaroche/

Werner Lang
Professor for Energy Efficient and Sustainable Design and Building at TUM, Munich http://www.enpb.bgu.tum.de/en/home/

Benson Lau
Arch. Benson Lau BAAS (Hons) DipArch/MSC (UCL) MPhil (Cantab) RIBA

Sanda Lenzholzer
Professor of landscape architecture and urban design at Wageningen University; one of her focuses being urban climate adaptation. http://www.wageningenur.nl/en/Persons/dr.dipl.ing.-S-Sanda-Lenzholzer-MA.htm

Fabrizio Leonforte
Eng., PhD, Adjunct Professor of Building Physics at Politecnico di Milano.

Florian Lichtblau
30 years experience in practice, research, teaching of sustainable architecture. www.lichtblau-architekten.de

Elena Lucchi
Senior Researcher in "Building Physics", EURAC Research, Bolzano (Italy) and Visiting Professor of "Building Physic", School of Architecture of Politecnico di Milano, Milano (Italy).

Michele Manigrasso
Ph.D in Architecture and Urban planning. Research filed: mitigation of risk and adaptation to climate change.

Leonardo Marques Monteiro
Architect, PhD. Lecturer/Researcher at the University of Sao Paulo, Brazil. http://lattes.cnpq.br/4245881406584245

Marco Merla
Sustainability consultant, energy certifier and BREEAM International NC assessor at Deerns Italia (Milan office). www.deerns.it

Fabrizio Mezzalana
Architect dealing with Universal and Inclusive Design, Environmental Comfort and Social Sustainability in Architecture http://www.slideshare.net/fabmezzalana

Gianluca Minguzzi
Architect, lecturer of environmental design and secretary of the International Prize for Sustainable Architecture.

Erwin Mlecnik
PhD. Civ. Eng.-arch., R&D @TU Delft & @PHP Berchem www.otb.bk.tudelft.nl www.passiefhuisplatform.be

Sameh Monna
Assistant prof. at Architectural Engineering Department, An-Najah National University, Palestine. http://staff.najah.edu/samehmonna

Guido Moretti
Former professor-researcher at the Department of Architecture and Territorial Planning, University of Bologna, Italy. www.gmorettistudio.it

Emanuele Naboni
Associate Professor of Sustainable Design. Institute of Architectural Technology, The Royal Danish Academy, Schools of Architecture and Founder of e3lab Environmental Sustainable Design Consultancy. www.e3lab.org www.kadk.dk/en/institute/architecture-and-technology

Edward Ng
Yao Ling Sun Professor of Architecture of The Chinese University of Hong Kong.
www.edwardng.com

Eduardo de Oliveira Fernandes
Professor Emeritus University of Porto, vice president of PLEA (1987-91).

Michele Olivieri
Senior architect at MCArchitects Srl, PhD in Building Technology

Maria Federica Ottone
Professor of Environmental Design, University of Camerino, School of Architecture and Design.

Rehnuma Parveen
PhD Candidate, UofA
http://www.adelaide.edu.au/directory/rehnuma.parveen

Giulia Pentella
PLEA2015 Program Chair, Executive Director of Building Green Futures, Architect and Researcher at MCArchitects Srl, Environmental Design Consultant, Lecturer of sustainable architecture

Rajan Rawal
Executive Director, Centre for Advanced Research in Building Science and Energy, CEPT University, Ahmedabad
www.carbse.org

András Reith
Ass. Prof. Andras Reith, PhD, Moholy-Nagy University of Art and Design, Hungary.
www.abud.hu

Valentina Resente
Architect/urban development and reconstruction
www.studioazue.eu

Jorge Rodríguez Álvarez
AA School of Architecture, London, UK and University of A Coruña, Spain
sed.aaschool.ac.uk

Jean-François Roger France
Prof. (Diparch, lecturer UCL Brussels), MA (AASchool) Partner GREENARCH architecture +environment sprl.
www.greenarch.be
http://www.uclouvain.be/loci

Alessandro Rogora
Full professor in Building technology at the Polytechnic University of Milan.

Flavio Rosa
Eng, Ph.D Energy Science, Post doc and Adjunct Professor Environmental Building Physics Roma Sapienza University.

Monica Rossi
Arch., PhD and Full Professor for "Constructive Design and Energy Efficient Building" at the Department of Civil Engineering of the HTWK Leipzig, Germany.

Fernando Ruttkay Pereira
Professor at the Federal University of Santa Catarina, Brazil.

Matheos Santamouris
Professor at the National and Kapodistrian University of Athens, Physics Department, Group Building Environmental Research Panepistimioupolis Athens, Greece.
http://mat.santamouris.dinstudio.com/

Francesca Sartogo
Eurosolar Italy President, architect for historical conservation, energy and environmental research. 2001 Architecture European Solar Prize.
www.eurosolaritalia.org

Elena Scattolini
Architect PhD candidate at Politecnico of Milan, she is working in cooperation with ENEA

Rosa Schiano-Phan
Principal Lecturer in Architecture and Environmental Design, Department of Architecture and the Built Environment, University of Westminster, London
http://www.westminster.ac.uk/about-us/our-people/directory/schiano-phan-dr-rosa

Silvia de Schiller
Arch.UBA + PhD Oxford, Consultant Professor UBA, Director, Research Centre Habitat & Energy, FADU-UBA.

Tobias Schrag
Professor at THI, working on energy efficiency and integration of renewable energies in buildings.
http://www.thi.de/hochschule/fakultaet-maschinenbau/personen/professoreninnen/prof-dr-ing-tobias-schrag.html

Heide Schuster
Prof. Dr.-Ing, Professor for Energy Design - Owner of BLAUSTUDIO.
www.blaustudio.de
www.fra-uas.de

Amedeo Scofone
Arch March, environmental Design Consultant working for WSP UK.
http://www.archilovers.com/amedeo-scofone/

Gianni Scudo
Full Professor in Building Technology at the Polytechnic University of Milan

Edna Shaviv
Honored by ASES as PIONEER IN PASSIVE SOLAR ENERGY.

Cesarina Siddi
Associate Professor in Architecture at University of Cagliari, member of the Regional Technical Committee for Urbanism (CTRU).
http://people.unica.it/cesarinasiddi/

Matthias Sieveke
Prof. Dr.-Ing., Dekan Hochschule Trier, Architekt BDA, Trier – München.
www.sieveke-architekten.de

Joana Carla Soares Gonçalves
Associate Professor of Architectural Design of FAUUSP - Faculty of Architecture and Urbanism of the University of Sao Paulo.

Alessandro Speccher
LEED AP BD+C , ILFI Ambassador, GBC Italia Education Manager.

Thanos N. Stasinopoulos
Dr. Architect Engineer NTUA AAGradDipl. (Energy).

Sadia Subrina
Architect, Lecturer, MSc, K U Leuven

Nobuyuki Sunaga
Prof. Tokyo Metropolitan University, Dept. of Arch.
www.comp.tmu.ac.jp/sunaga.lab/

Kheira Anissa Tabet Aoul
Architectural Engineering Department, College of Engineering, United Arab Emirates University, United Arab Emirates.
www.engg.uaeu.ac.ae

Filippo Taidelli
Architect and director Filippo Taidelli Architects, professor of master course in environmental design.
www.filippotaidelli.com

Chiara Tonelli
Associate professor of Architectural Technology at Roma TRE University, Italy and Faculty Advisor for Solar Decathlon 2012 and 2014

Maureen Trebilcock
Architect, PhD. Associate professor of sustainable architecture, Universidad del Bío-Bío, Concepcion, Chile.

Brenda Vale
Designed the UK's first autonomous house and settlement with Robert Vale.

Juan Vallejo
DiplArch MSc PhD candidate, Environmental Design Analyst - Architect.
juanan.v@naturalcooling.co.uk
http://naturalcooling.co.uk

Marika Vellei
Engineer, Msc, Phd candidate/Department of Architecture & Civil Engineering, University of Bath

Fabio Viero
Head of Building Physics and Sustainability at Manens-Tifs in Verona, Italy. Member of the USGBC Integrative Design Process Working Group and chairs the GBC Italia Energy&Atmosphere Committee.
www.manens-tifs.it

Yupeng Wang
Postdoc Fellow in Concordia University, UHI group.
https://www.researchgate.net/profile/Yupeng_Wang7

Filippo Weber
March in Sustainable Environmental Design, he runs FWA focusing his activity on the development of new sustainable paradigms of the built environment.
filippoweber.com

Paulina Wegertseder
Architect, Doctor of Architecture and Urbanism. Professor of sustainable architecture, Universidad del Bío-Bío, Concepcion, Chile.

Zhenzhou Weng
BEng MSc PhD candidate, Environmental Design Tool Developer

Simos Yannas
PLEA founding member and permanent Secretary. Director, Sustainable Environmental Design, Architectural Association School of Architecture, London, UK.
sed.aaschool.ac.uk

Grace Yepez-Salmon
Architect and doctor specialized in sustainable planning, professor researcher at the architectural school of Bordeaux and project manager in Nobatek.

Edoardo Zanchini
Architect Ph.D, Legambiente national vicepresident.
www.legambiente.it

Tan Zheng
MSc PhD candidate/The Chinese University of HK.

Right for a Quality Shelter
1st Parallel Session
DAY 1
14:00 – 16:00

Right for a Quality Shelter
2nd Parallel Session
DAY 2
10:30 – 12:30

Right for a Quality Shelter
3rd Parallel Session
DAY 2
14:00 – 16:00

Post Carbon Cities
1st Parallel Session
DAY 1
14:00 – 16:00

Post Carbon Cities
2nd Parallel Session
DAY 2
10:30 – 12:30

Post Carbon Cities
3rd Parallel Session
DAY 2
14:00 – 16:00

Improving perFORMance
1st Parallel Session
DAY 1
14:00 – 16:00

Improving perFORMance
2nd Parallel Session
DAY 2
10:30 – 12:30

Improving perFORMance
3rd Parallel Session
DAY 2
14:00 – 16:00

Knowledge Transfer
1st Parallel Session
DAY 1
14:00 – 16:00

Knowledge Transfer
2Nd Parallel Session
Day 2
10:30 – 12:30

Knowledge Transfer
3rd Parallel Session
DAY 2
14:00 – 16:00

+ Resilience – Vulnerability
1st Parallel Session
DAY 1
14:00 – 16:00

+ Resilience – Vulnerability
2nd Parallel Session
DAY 2
10:30 – 12:30

+ Resilience – Vulnerability
3rd Parallel Session
DAY 2
14:00 – 16:00

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Right for a Quality Shelter

1st Parallel Session

DAY 1

14:00 – 16:00

CHAIRMEN

Enrico Fabrizio ..... Table 1
Rosa Schiano-Phan ..... Table 2
Giulia Pentella ..... Table 3

EXPERIENCES OF HOMEOWNERS REGARDING NEARLY ZERO-ENERGY RENOVATIONS AND CONSEQUENCES FOR BUSINESS MODELS

Erwin Mlecnik, Ad Straub

TU Delft, Faculty of Architecture and the Built Environment, OTB Research for the Built Environment

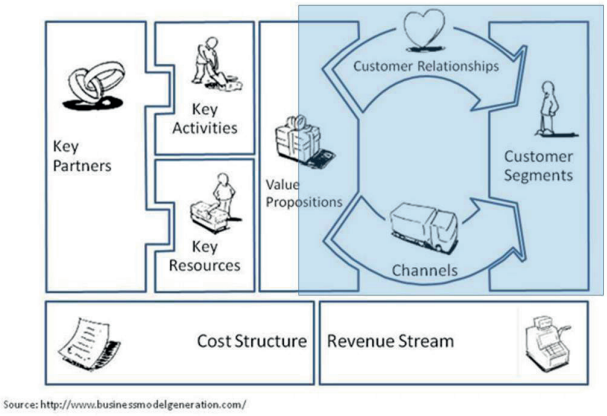


Fig 1: Needed input for the business model generation canvas (based on Osterwalder & Pigneur, 2010)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

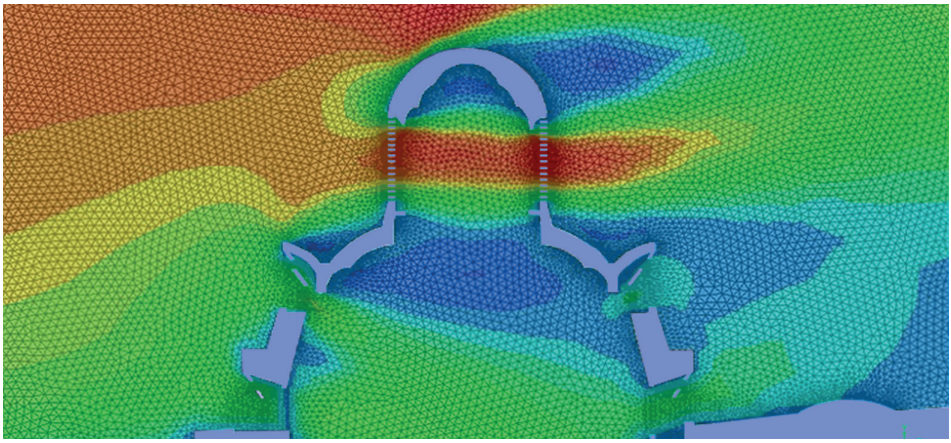
Pathways should be explored so that supply-side actors can present integrated renovations to homeowners in such a way that customers are confident with "nearly zero-energy" renovation. Understanding the real wishes of homeowners regarding integrated renovation can help to develop appropriate business. In the framework of the Intelligent Energy Europe project COHERENO (www.cohereno.eu), research was done for the market development of such renovation of single-family homes in five European countries. A coherent study was performed that encompasses an overview of, and experiences from, homeowners - involved in realized projects in order to determine business model input for increasing integrated renovations. The research showed that frontrunner-homeowners who decided for nearly zero-energy renovations were either younger or more mature families, mainly motivated by energy targets and indoor and environmental concerns. They actively searched experienced actors and attached high value to the energy interest of professionals. They expected professionals to have reference projects they can visit, to deliver a feasible planning and to assure project timing.

Detected customer value propositions and quality assurance procedures are now introduced in collaborative business model development cases to find pathways to increase customer confidence and the market uptake of integrated home renovations.

KEYWORDS: *INTEGRATED RENOVATION, BUSINESS MODELS, SINGLE-FAMILY HOUSES, USER EXPERIENCES, ACTOR COLLABORATION*

PASSIVE COOLING DESIGN: APPLICATION OF RESIDENTIAL VERNACULAR ENVIRONMENTAL CONTROL SYSTEM FOR MODERN LIVING IN HOT-DRY CLIMATE, STUDY OF BOROUJERDI's HOUSE IN KASHAN, IRAN

Mehregan Alimi *University of Nottingham*
Benson Lau *University of Nottingham*



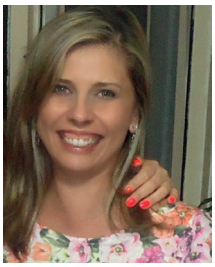
Air flow pattern through the Boroujerdi's house generated by the simulation model.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper investigated the traditional passive cooling systems in the vernacular architecture of Iran and revealed the potential environmental benefits while achieving low energy consumption and providing comfort. This is particularly important in extreme climates where mechanical system is costly and expensive to run. The subject of this study is a listed existing historical house, operating on an ingenious passively controlled environmental design system. This study looked into the architectural features of Boroujerdi house such as; building structure, special traditional architecture elements, shapes and forms, and to assess the integration of passive responsive design strategies in the building. The issues related to building performance are complex, and the research methodology adopted is to establish specific target areas of interest as a means to obtain representative results. Many vernacular technologies are energy efficient and sustainable in principle, although some cultural and ecological changes have stopped them function satisfactorily. The key challenge here is to learn the fundamental environmental design lessons and principles in vernacular architecture, and find meaningful application in contemporary building design. The research findings revealed the responsive interaction between climatic variables (pressure, velocity and temperature), building shape and form (internal and external geometry), and occupants' comfort in the chosen building. The building performance analysis results indicated that the comfort conditions are improved or enhanced to a certain extent by the specific architectural design of the house. Results also showed a pressure difference induced by the ceiling geometry which assists air movement and help remove hot air from the building top, which in turn admit cold air entering the ground level during day time, therefore, providing favourable living conditions.

KEYWORDS: *VERNACULAR ARCHITECTURE, PASSIVE COOLING, CLIMATIC RESPONSIVE DESIGN, HUMAN COMFORT.*



VERIFICATION OF THE HIDDEN "RIGHT TO THE SUN" IN MASTERS PLANS I, II AND III IN THE CITY OF PELOTAS-RS, BRAZIL

Saionara Dias Vianna, Mariana Estima Silva, Celina Britto Correa

PROGRAU - Universidade Federal de Pelotas / UFPEL

Fig 1: Study's Pilot Zone in aerial image and modeling with solar envelopes.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

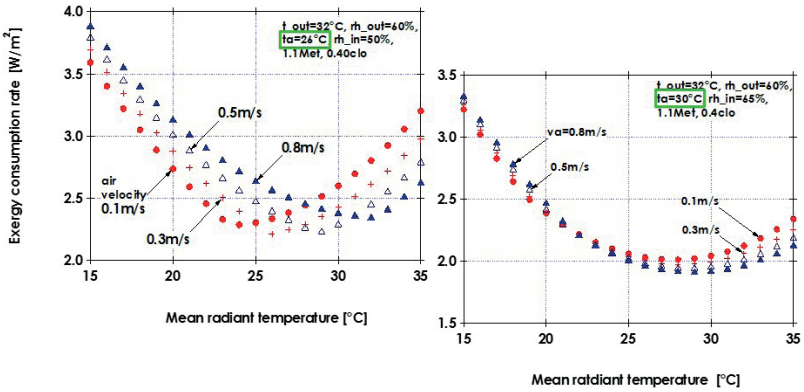
This work aims to talk about the importance of the creation of urban indexes that aim at good comfort conditions for the buildings, not having as objective only big numbers of building potential. This was done through an analysis of legislations compared to studies of insolation and application of the solar envelope concept in a pilot test zone, in the city of Pelotas-RS, Brazil. These analyses, made through computational models, can be applied to other cities as well, in order to verify if the established urban indexes show good conditions of natural lighting in the buildings. Therefore, the revision of legislations helps improving them, providing solutions for the development of buildings with better conditions of health and energy efficiency.

KEYWORDS: *Solar envelope, Urban indexes, "Right to the Sun".*

INDOOR-ENVIRONMENTAL REQUIREMENT FOR THE OPTIMIZATION OF HUMAN-BODY EXERGY BALANCE UNDER HOT/HUMID SUMMER CLIMATE

Masanori Shukuya

Ph.D., Professor, Department of Restoration Ecology and Built Environment, Tokyo City University



A system and its environment. The system performs "exergy-entropy" process. The exergy balance equation is derived from energy and entropy together with the environmental temperature.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper discusses, from the recent findings in human-body exergy research, why the passive-technology based measures, such as better thermal insulation of exterior building envelope systems and more efficient solar control of window systems, come to the top priority. The human-body exergy consumption rate, which is considered to be a kind of human thermal-stress indicator, varies very much with the change in mean radiant temperature and there is a value of mean radiant temperature giving the smallest possible human-body exergy consumption rate under a chosen set of air velocity and air temperature indoors. In such a case, where room air temperature is higher than the conventional target value in mechanical air cooling, the lowest possible human-body exergy consumption rate emerges with the mean radiant temperature ranging between 26 and 29 C. The higher the air velocity is within a range to be easily available by natural ventilation, the lower the human-body exergy consumption rate becomes. These results suggest that the first priority for summer seasons especially in hot and humid climate regions is to reduce solar heat gain from windows by external shading and from electric lighting and others in order to make the mean radiant temperature stay sufficiently low, but not too low. Such indoor radiant control primarily to be done by passive-technology measures should allow more chances of natural ventilation and thereby right-sized radiant cooling systems with the use of natural exergy resources.

KEYWORDS: *Human body, Exergy consumption, Radiant temperature, Air velocity, Thermal comfort*

EFFECT OF HIGH MASS TRADITIONAL BUILDINGS IN MODERATING INDOOR TEMPERATURES IN THE MEDITERRANEAN CLIMATE

Eleni Malaktou, Maria Philokyprou, Aimilios Michael, Andreas Savvides

University of Cyprus

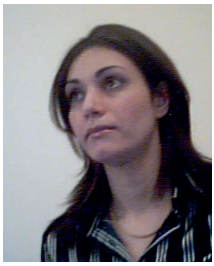
Traditional settlements under investigation. Images represent typical street and building configurations in three settlements of Cyprus, namely, Maroni, Pera Orinis and Askas.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The present study aims at evaluating the effect of thermal mass in moderating indoor maximum temperatures in the climatic context of the Mediterranean. For this purpose, in-situ measurements in high mass traditional buildings were carried out, taking Cyprus as a case study. A total of 25 traditional spaces —located in three settlements which are characterized by different local climatic conditions— were monitored during the hot, summer period, between the 1st and 31st of August 2014. The analysis of collected data referring to environmental aspects of the spaces examined, showed that outdoor climatic variables constitute a key parameter affecting the performance of thermal mass during the hot, summer period. The effect of thermal mass in lowering indoor temperature maxima below outdoor temperature maxima significantly varied among the climatic regions under study. Traditional spaces in climatic regions which present large diurnal temperature fluctuations, demonstrated larger indoor maximum temperature reductions compared to the spaces located in climatic regions with relatively small diurnal temperature fluctuations and high night-time temperatures. Furthermore, it is found that the indoor maximum temperature in the spaces under study is affected by the combined effects of outdoor maximum temperature and outdoor diurnal temperature fluctuation. The study discusses these findings and provides a comparison with other studies dealing with the examination of the effects of outdoor climatic conditions on indoor temperature maxima.

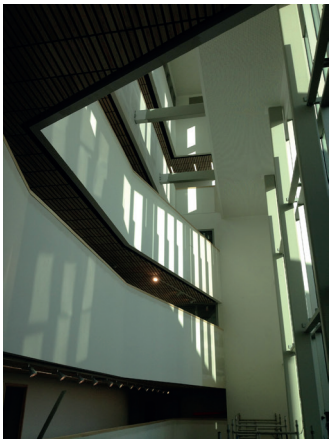
KEYWORDS: *TRADITIONAL BUILDINGS; THERMAL MASS; MEDITERRANEAN CLIMATE; PASSIVE COOLING*



POST OCCUPANCY EVALUATION OF DAYLIGHTING AND THE THERMAL ENVIRONMENT IN EDUCATION BUILDING

Sura Al-Maiyah, D. Brett Martinson
University of Portsmouth

Hisham Elkadi
University of Salford



The Eldon Campus, Atrium Space of the New Building and 3rd Floor Studios

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The School of Architecture at Portsmouth has moved into its new building in December 2013. The new building features a number of environmentally friendly design characteristic, such as advanced natural ventilation, daylighting and a ground source heat pump. The relocation of the architecture programmes has provided an opportunity for a Post Occupancy Evaluation (POE) study to provide data that can assist the students in understanding the role of human factors in controlling the internal conditions of their working spaces.

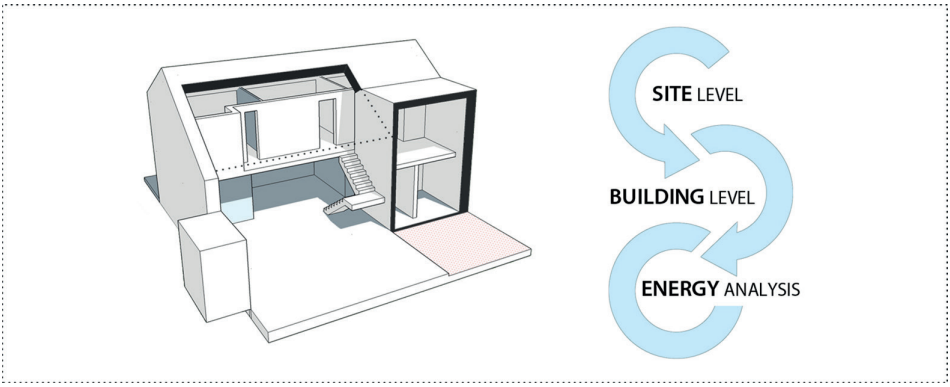
Whereas POE studies have gained an increasing attention recently, there are a limited number of POE studies that focus on newly occupied higher education institutions. Working closely with the University Department of Estates, the project architect and an independent advisor this study examined the internal conditions and perception of comfort of the new Eldon West to assess how well the building performs for those occupying it. The evaluation includes conducting occupant satisfaction surveys and monitoring the internal environmental conditions of the building using temperature and light data loggers and hourly temperature rerecords obtained from the Building Management System (BMS). This paper reports the results of the first phase of the occupant satisfaction survey (both students and staff) assessing their perception of comfort and personal preferences against comfort codes and building regulations.

KEYWORDS: *POE, Education buildings, Occupants satisfaction, Daylighting and Thermal comfort*

ENERGY EFFICIENT AND MOISTURE SAFE ROW HOUSES IN SOUTH SWEDEN

Iason Bournas, Marwan Abugabbara, Yuchen Yang

Lund University



A holistic approach from the early to the final design stage

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

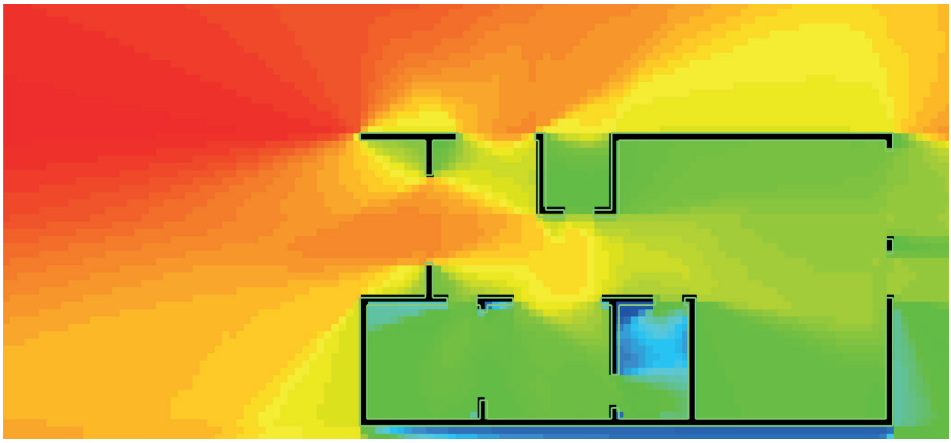
This project consists of a thorough study of an energy efficient and moisture safe row-house, located in the Nordic climate of Sweden. Climate and site analysis, building scale design decisions and finally the evaluation and optimization of its energy performance were different steps of a holistic process aiming at the architectural quality, energy efficiency, comfort and the well-being of users. The final house design is addressing the spatial requirements of the on-going population increase, that is imminent in the developing countries, but while doing so, it exerts minimum impact on environmental resources and avoids ecological damage. The passive house standards had to be reached by applying passive heating strategies to reduce the heating demand. Increasing thermal insulation thickness and thermal mass elements in the house had a significant role in reducing heat loss and keeping the house warm in winter nights. Other passive house standards, U-values of envelope elements as well as the window-to-wall area played an important role. The moisture risks had to be avoided and the wooden construction proved to function well under the climatic conditions. An innovative method of timing the shading and nighttime natural ventilation was included as a passive strategy for natural cooling. Time period, position and type of shading was optimized according to hourly data and the correlation of internal and solar gains, and their impact on the operative temperature. To ensure summer wind cooling, the interior spatial distribution and circulation areas were designed to exploit the stack effect and cross ventilation by the opening of specific windows. water heater. The overall energy intensity would finally be assessed and further minimized by the use of an active photovoltaic system on the roof, to exploit the renewable energy of the sun.

KEYWORDS: *Passive house, night-time ventilation, movable shading, PVs, DHW*

THE POTENTIAL OF USING SPACE SYNTAX APPROACH TO PREDICT THE EFFECT OF BUILDING SPATIAL CONFIGURATION FOR SUMMER THERMAL COMFORT

Xiaoyu Du, Regina Bokel, Andy van den Dobbelsteen

Faculty of Architecture and the Built Environment, Delft University of Technology



the result of VGA (From red to deep blue, the connectivity and integration value is from big to small.)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

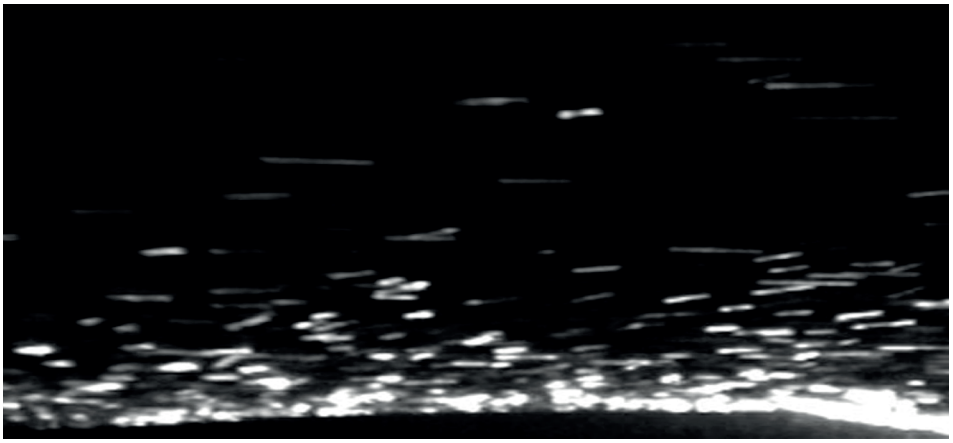
Space syntax is a well-known technique for the quantitative analysis of spatial relationships and social patterns in buildings and urban systems. On the other hand, in building thermal performance research field, adaptive comfort theory is based on the concept that thermal comfort is highly influenced by personal preference and contextual factors that are commonly found in naturally ventilated buildings. In this paper, the authors try to find the relationship between spatial configuration and summer thermal comfort and the potential to use space syntax approach to predict the effect of spatial configuration for thermal comfort. In detail, the relationship between spatial configuration, air movement and occupants' activity were investigated. As a case study, a free-running house with diverse spaces, which lies in the hot and humid climate area, was analysed by space syntax approach. The results were compared with the measured wind velocity and CFD simulation. It is found that the spaces which have high "connectivity values" and "integration values" in space syntax analysis can provide more natural ventilation which is important to increase the thermal comfort sensation in hot and humid weather condition without using active cooling. Therefore, occupants prefer to move to these spaces. This result shows that there is a potential in applying the space syntax approach on the building spatial configuration in predicting the air movement and occupants' movement. It is possible to improve building thermal performance in the architectural early design stages through spatial configuration.

KEYWORDS:*SPACE SYNTAX; SPATIAL CONFIGURATION; SPATIAL PERMEABILITY; OCCUPANTS' BEHAVIOUR; AIR MOVEMENT; ADAPTIVE THERMAL COMFORT*

MODELING AIRFLOW IN URBAN FORM AGAINST SAND ACCUMULATION IN TOWN OF TIMIMOUN IN ALGERIA

MESTOUL-Djamel, BNEQLEM-Rafik,
LAE/EPAU

ADOLPHE-Luc
LRA/ENSA



saltation

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In our present research, we focus on the modeling of airflow related to extreme weather events and natural disasters, such as sand accumulation, with urban form studies. The objective is to find which urban form can promote sand passing and reduce as much as possible stagnation of sand in the built environment (streets, alleys, etc.). The urban form design is discussed through the numerical simulation of airflow.

We simulate the airflow behavior, especially the wind speed, which is responsible of sand stagnation in some specific configurations. Various configurations of buildings were considered and different airflow behaviors were thus observed. The method of modeling was verified by following some best practice guidelines. In the literature, wind speed was found having a great impact on the sand stagnation.

In this study, a correlation was made between urban wind speed and morphological parameters such as width and length of street, building height and building density. Results of our simulations show that, some certain types of urban form with proper values of parameters can promote wind speed and help blow away the accumulated sand in the city.

KEYWORDS: *NUMERICAL SIMULATION CFD, SALTATION, SAND ACCUMULATION, URBAN FORM*

THE STELLAR APARTMENTS: DYNAMIC STORIES FROM PASSIVE BUILDINGS

Eric Schmidt, Lindsay Rasmussen, Ashley Tuffo, Annie Chiang, Alison Kwok

University of Oregon

Stellar Apartments Passive House Building (image courtesy of Bergsund Delaney Architecture)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Energy and building performance monitoring are important pursuits for the advancement of sustainable design. Especially in the United States, where home construction is often code-minimum, performance monitoring helps validate new and effective techniques. With the growing movement of passive house design in the US, energy monitoring and construction documenting aids future designers and builders push boundaries. The research presented herein is a part of this pursuit. The Stellar Apartments' passive house building, of Eugene, OR, is the first certified affordable, multi-family passive house in the US. Completed in 2013 the building has been undergoing continuous energy monitoring alongside an identical building built to an optional Oregon State energy standard, Earth Advantage. The two buildings serve as a pilot-study for the architects, contractor, and consultants as they dealt with the complexity of passive house, many for the first time. The energy data have been used to inform the buildings' developer, architect, and contractor's practice, as they push for a middle ground of affordable and efficient housing. This paper not only highlights the energy data from the first 18 months of collection but also recounts narratives from the design and construction process. Interviews were held with members of the design team, contractor, developer, and property management and will hopefully serve to enlighten others as they pursue advanced buildings. The interviews revealed a number of themes about collaboration, innovation, expense, and risk-taking with this first-time project. In summation, this paper examines both the energy efficiency of the building, and also the trials and success of the team that built it, and is presented to help support future endeavors, and promote better, healthier, more economically feasible buildings.

KEYWORDS: *Passive House, Earth Advantage, affordable, multifamily housing, Stellar, monitoring*

SUSTAINABILITY AND HEALTHCARE DESIGN: BLOOD DONOR CENTER OF PARÁ – BRAZIL

Marta Adriana Bustos Romero,
Aline Curvello da Costa Nemer,
Ana Carolina Cordeiro Correia Lima,
Gustavo Alexandre Cardoso Cantuária
UnB – Brasília University

Building Proposition for the Blood Donor Center of Para

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Since 2010, the Ministry of Health in Brazil has made a partnership with the Sustainable Architecture and Urban Planning Solutions Laboratory (LaSUS), from the University of Brasilia, to develop the immersion of bioclimatic concepts and healthcare designs in hospitals, more specifically haematological and haemotherapy hospitals. The main objective of the program is to generate comfort for the users, employees and also increasing the sustainability of the analysed buildings. The research presents the study case of the Blood Donor Center of the state of Para, located in the Amazon region, in the downtown area of the city of Belem. The building has a rectangular structure, with a blood donation, processing and test areas and prevision of expansion by the construction of a new building in the neighbouring plot. The emphasis of this study is the sustainable environmental restoration of the Blood Donor Center, which is based on the Environmental Integration Assessment method developed by the LaSUS Lab. The method is composed of the Post-Occupation Assessment; the energetic evaluation of the building based on Retrofit; energy efficiency evaluation of the building envelope design based on Brazilian legislation; and simulations with ENVI-met, EnergyPlus and Autodesk Ecotect Analisys softwares. The results of this article validate the interface of concepts as guidelines for the rehabilitation of health care facilities. The goals were set based on the problems diagnoses phase, being well detailed according to each peculiarity of the building. Results showed that it is possible to reduce the annual energy consumption up to 12%, obtaining the level "A" of energy efficiency of the building envelope, increasing the thermal, lighting and acoustical comforts of the internal spaces.

KEYWORDS: *Sustainability, Humanization, Health Buildings*

LESSONS FROM THE MASTERS: A STUDY OF TERTIARY EDUCATIONAL BUILDINGS IN INDIA

Megha Nanaiah, Simos Yannas

AA SED Sustainable Environmental Design, Architectural Association School of Architecture
London UK

View of the first floor corridor at IIM-B

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

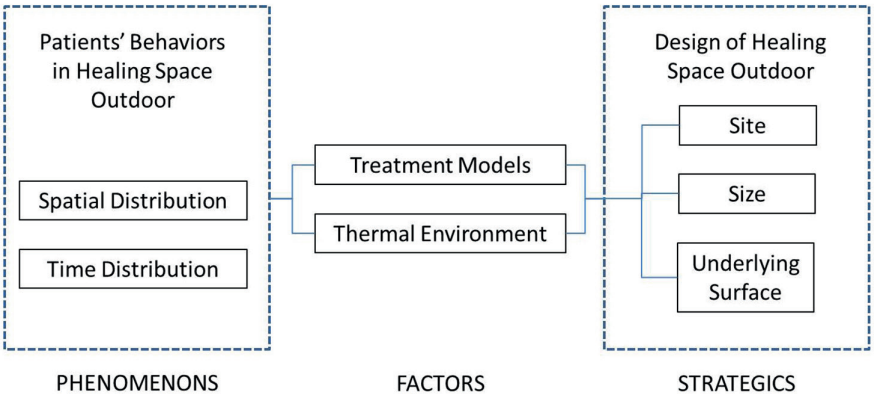
The past few years have seen a steep rise in the number of tertiary educational institutions built in the city of Bangalore following the city's population growth. With each new building, the architectural quality seems to be deteriorating while failing to respond to the region's tropical climate, adopting an approach that isolates occupants inside air conditioned boxes. This has resulted in an increase in peak electric loads and in complaints with poor indoor air quality. The paper questions this dependence on air conditioning and highlights the importance of passive techniques, especially those of solar protection that are so essential in the tropics. It draws lessons from the study of two landmark buildings in India, the Indian Institute of Management in Bangalore and the CEPT School of Architecture in Ahmedabad. The fieldwork, environmental measurements and analytic work undertaken on these buildings reveal principles of climate-responsive architecture from the early stages of design. The results presented here provide the basis for guidelines to ensure environmentally responsive architecture in tertiary educational buildings.

KEYWORDS: *transitional spaces, Indian Institute of Management-Bangalore, School of Architecture-CEPT, shading, tropics.*

DESIGN STRATEGIES OF HOSPITAL HEALING SPACE OUTDOORS IN HOT AND HUMID REGION

Chunyang Zhang, Dejian Peng

School of Architecture, South China University of Technology



Framework of the Analysis

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Hospital is a place for treatment, and it is also important for patients' recovery when hospital has a well-design and comfortable healing environment. In hot and humid climate, patients usually have strong desires to enjoy themselves in the open air.

The paper makes a full analysis of thermal environment, spatial distribution and time distribution of hospital healing space outdoors at the outset. Then, with the consideration of treatment models, the paper discusses some points about how to design hospital healing space outdoors, in the aspects of site selection, size and landscape.

KEYWORDS: *Human-oriented, Patients' Behaviours, Courtyard Environment*

SUSTAINABLE DESIGN AND NATURAL CONDITIONING FOR A SENSITIVE SITE: SEYMOUR AIRPORT AND NATIONAL PARK BUILDINGS IN GALAPAGOS

John Martin Evans, Silvia de Schiller

University of Buenos Aires

Seymour Airport Passenger Terminal, Galapagos, Ecuador

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Tourism, new buildings and urbanisation impacts threaten the Galapagos Islands, with a unique and vulnerable ecosystem, designated by UNESCO as a World Natural Heritage site in the Ecuador National Park. Two projects demonstrate the potential of low impact naturally conditioned buildings: Seymour Airport Passenger Terminal and the Galápagos National Park Study to improve performance of new and existing buildings. The 6,000 m2 airport terminal, handling 70,000 passengers a year, with high internal gains in a demanding equatorial climate, achieves comfortable indoor environment in all public spaces, combining total solar shading, cross ventilation, insulated and reflective roofing, floor to ceiling heights for thermal stratification and natural extraction of hot air. Internal spaces also have natural daylight, using patios and well-protected skylights. Additionally, the building includes recycled wastewater, recycled materials, and provides full accessibility in all public spaces, generating a significant proportion of the remaining energy demand with PV panels that also provide shade for passengers. This experience contributed to the Galapagos National Park Sustainable Building Study to reduce environmental impacts, applying natural conditioning in buildings with different functions, including offices, housing, interpretation centres, and research laboratories. A survey of existing buildings and temperature measurements shows the importance of applying bioclimatic design strategies to improve comfort and reduce the dependence on imported fossil fuels. Improvement of existing housing for visiting scientists, volunteers and park staff and a manual for sustainable building design contribute to the conservation of this unique ecosystem, demonstrating the potential of bioclimatic design, renewable energy and sustainable building criteria.

KEYWORDS: *Natural conditioning, bioclimatic design, equatorial climate, airports, housing, Galapagos.*

POST-OCCUPANCY MONITORING OF TWO FLATS IN MADRID: DEVELOPMENT AND ASSESSMENT OF A MIXED METHODS

Elena Cuerda, Fco. Javier Neila Gonzalez
Technical University of Madrid

Natalia Romero Herrera, Olivia Guerra-Santin
TUDelft, Faculty of Industrial Design

Facade of non-renovated and renovated buildings

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Recent research has shown large differences between the expected and the actual energy consumption in buildings. The differences have been attributed partially, to the assumptions made during the design phase of buildings when simulation methods are employed. More accurate occupancy profiles on building operation could help to carry out more precise building performance calculations. This study focuses on the post-occupancy evaluation of two apartments in Madrid within the same building complex.

The aim of this paper is to present the mixed-methods methodology to assess thermal comfort and building practices used in the case studies, and to discuss the shortcomings and opportunities associated with it. The mixed-methods methodology offers strategies for integrating qualitative and quantitative methods to investigate complex phenomena. This approach is expected to contribute to the growing knowledge of occupants' behaviour and building performance by explaining the differences observed between energy consumption and thermal comfort in relation to people's saving and comfort practices and the related experiences, preferences and values.

KEYWORDS: *Post-occupancy, Energy, Building performance, Monitoring, Occupant behaviour*

DESIGN STRATEGIES, ENVELOPE PERFORMANCE AND RENEWABLE ENERGY FOR NEW SOCIAL HOUSING

Silvia de Schiller, John Martin Evans

Research Centre Habitat and Energy, University of Buenos Aires

Typical social housing used as a base line for energy efficiency evaluation

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

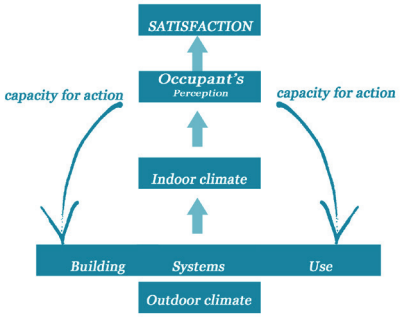
The research project shows that the challenge of energy reduction in housing can be achieved by applying bioclimatic design strategies, energy efficiency measures and solar energy installations in different regions of Argentina. This demonstrates the potential contribution to new housing standards, relevant to social, environmental and economic sustainability. By integrating design, energy efficiency and renewable energy, the project shows the potential reduction of 30 %, a significant proportion of the demand, highly dependant on climatic variations. Energy paths and interactions between supply, uses and heat losses were analysed to evaluate energy performance of social housing in the wide range of environmental conditions in Argentina. The first scenario evaluates improved thermal performance in conventional housing design, the second modifies design to achieve better performance in different climates, and the final scenario quantifies additional contributions of active solar systems for hot water and space heating. The impact of different user behaviour was also estimated. With the initial scenario, an average of 48 % of total energy demand for heating achieved 27 % overall reduction and the potential to reach it varies widely according to climate, building technology and user behaviour. If improvements of thermal performance alone contribute valuable savings, the combination of design, insulation and installations can provide significant support to reduce demand, develop new standards and modify the national energy matrix, to promote a more sustainable built environment.

KEYWORDS: *SUSTAINABLE SOCIAL HOUSING, DESIGN STRATEGIES, ENERGY EFFICIENCY, RENEWABLE ENERGY.*

MEASURE: ESTABLISHMENT OF A QUESTIONNAIRE TO EVALUATE OCCUPANTS' SATISFACTION ADAPTED TO HIGH ENERGY PERFORMANCE RESIDENTIAL BUILDINGS

Dartevelle Olivier, Obyn Sophie

UCL, LOCI, Architecture et Climat



factor of influence of occupant's satisfaction

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In Europe, since the application of the European Energy Performance of Buildings Directive (EPBD), energy requirements have been ever stronger, leading the construction industry to design buildings whose energy consumption is continuously reduced. Nevertheless, no large-scale experience feedbacks on the occupants' satisfaction of high efficient residential buildings are available in Wallonia.
Therefore, the first MEASURE project objective is the evaluation of occupants' satisfaction in high energy performance dwellings by the use of a questionnaire. This questionnaire, divided in several parts, covers a technical description of the building and its systems, a global appreciation of the building in terms of respiratory, thermal, acoustic and luminous comfort and a detailed evaluation of the occupants' satisfaction. The responses should permit to identify attention points and improvements required to achieve a comfortable environment for occupants and increase the effectiveness of energy performance.
This paper focuses on the methodological approach used to establish a questionnaire adapted to the evaluation of the occupants' satisfaction in high energy performance dwellings. It describes the different stages of the questionnaire realisation: the identification of dependent and independent notions to study as well as indicators defining each notion, the focus-group step and the test of the questionnaire. Studied notions and related indicators are presented in link with the Walloon context.

KEYWORDS: *Comfort, Post Occupancy Evaluation, high energy performance residential buildings.*

A NEW DESIGN TO ACHIEVE THERMAL COMFORT IN LOW-INCOME COMMUNITY IN BANGKOK, THAILAND

Praew Sirichanchuen, Paula Cadima

AA School of Architecture, London, UK

Design Proposal for Sapanmai I Community, Bangkok, Thailand

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Traditional Thai architecture is well adapted to the climatic variations across Thailand and provides appropriate architectural design responses to climate, particularly in the context of passive design [1]. Present day shelters in Thailand are of poor quality leading to thermal discomfort. Moreover, the current government housing scheme was developed disregarding the climatic conditions, leading to overheating issues and inadequate natural ventilation [2]. Fieldwork was undertaken within the Sapanmai I Community in Bangkok to assess inhabitants' daily activities and to identify the main problems in the existing conditions [3]. Four dwellings, representing typical single and two floor contemporary typologies and including heavyweight and lightweight construction, were selected for the study. Analytical studies were carried out to assess the impact of various design solutions aiming at improving the environmental performance of a base case. These also included testing the environmental impact of the use of modern corrugated bamboo roofing sheets and doubled bamboo panel. The results show that, in addition to a careful design in regards to shading and ventilation, the use of bamboo, available locally, can replace existing corrugated roof panels and concrete structures. This provides the same thermal inertia which helps mitigating temperature fluctuations inside the dwellings improving the community dwellers' quality of life.

KEYWORDS: *Vernacular, Thai architecture, hot-humid climate, adaptive comfort, bamboo, natural ventilation, low-income housing*

INDOOR RADON AND AIR QUALITY INVESTIGATIONS IN NEW OR RENOVATED ENERGY-EFFICIENT SWISS SINGLE-FAMILY DWELLINGS

Goyette Pernot Joëlle, Hager Jörin Corinne - School of engineering and architecture of Fribourg, University of applied sciences of Western Switzerland, HEIA-FR
Pampuri Luca - University of Applied Sciences and Arts of Southern Switzerland, SUPSI

Mesqualair project logo

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

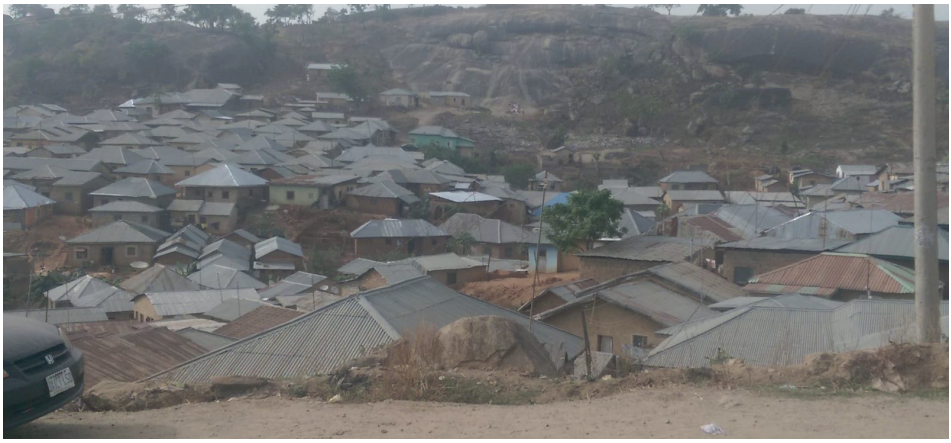
The perspectives of a new energy crisis subsequent to the depletion of natural resources along with the increase of energy costs make, more than forty years after the first oil crisis, energy savings a priority. This lead to rethink building practices so as to make it more sustainable and economical in terms of energy consumption by ensuring the air tightness and a good thermal insulation. Indeed, the less we ventilate such sealed houses, the more moisture, number and level of pollutants increase in the indoor environment. The deterioration of the indoor air quality and the appearance of occupants non-specific health disorders are the consequences. Preliminary results indicate the attention to pay to energy-efficient buildings. On the one hand, the concentration of indoor radon has a clear tendency to increase after an energy saving action. On the other hand, it appears that even though the new Swiss energy efficient houses seem less affected by this problem than the traditional renovated houses, or even transformed according to these label requirements, unexpected situations may still arise. People living in energy saving buildings need to be well informed about the risks and about "what-to-do and not-to-do" living in such "high tech" houses. Maintenance of technical installation can also be troublesome.

KEYWORDS: *Energy-efficient single family dwellings, radon concentration, indoor air quality*

AN INVESTIGATION INTO THERMAL COMFORT IN RESIDENTIAL BUILDINGS IN THE HOT HUMID CLIMATE OF SUB-SAHARAN AFRICA: A FIELD STUDY IN ABUJA-NIGERIA

Michael Adaji, Dr. Richard Watkins, Prof. Gerald Adler

Kent School of Architecture, University of Kent



Mpape, A typical low-income residential area in Abuja, Nigeria

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A field study was conducted to understand the real and preferred conditions of thermal comfort in low-income residential buildings in Abuja, Nigeria. Knowing the temperatures people are experiencing in their houses and the limits which residents can tolerate is a first step to proffer passive solutions to reduce discomfort. During the study, 40 people responded to a post occupancy questionnaire and two households were issued a comfort survey questionnaire. Physical measurements were taken simultaneously during the comfort survey in both an air-conditioned and naturally ventilated residential building. The ASHRAE and air flow sensation scale were chosen as voting scales. The results from this study show that during the monitoring period the average and maximum temperatures in an air conditioned residential building were 31°C and 34°C; and 33°C and 36°C for natural ventilated buildings in Abuja. This compares with the external average and maximum air temperatures of 31°C and 39°C.

KEYWORDS: *THERMAL COMFORT, LOW-INCOME, RESIDENTIAL BUILDING, POST OCCUPANCY SURVEY, COMFORT SURVEY.*

TOWARDS MITIGATIVE BUILDINGS AND URBAN ENVIRONMENTS

Dr. Rosa Schiano-Phan, Arch. Filippo Weber

University of Westminster

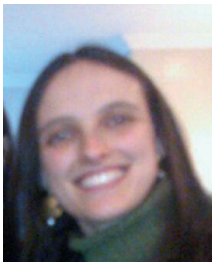
Paper's Key Words

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In recent years, the global environmental and energy agenda has placed great attention on building energy efficiency due to its substantial savings' potential. This attention has led to improvements in the efficiency of services, components and appliances; however, this has led to the following outcomes: 1) the focus on efficiency has created a disjointed approach between the design of the building as an envelope and that of its environmental control systems as mechanical add-ons, often leading to high up-front expenditures and to buildings as isolated systems; 2) especially in urban areas, the built environment and its energy processes highly affects the microclimate to the extent that today cities are at the forefront of the most rapid environmental and climatic changes, causing reduction in comfort and health and increasing buildings energy consumption; 3) building users' adaptive behaviour, expectations and potential active involvement in energy saving strategies are not sufficiently embedded into the design process and building operation, increasing the 'performance gap' and missing the opportunity for further energy savings. Considering buildings, surrounding environments and users as elements of the same (eco)system could drastically reduce energy expenditures and enable the transition to a low-carbon, sustainable and resilient society. Experimentations indicate that small scale mitigative actions would yield significant immediate improvements in the microclimate with advantages for outdoor and indoor comfort, enabling the application of passive strategies and reducing energy demand. Based on the above a new architectural paradigm is proposed: Mitigative Buildings and Urban Environments..

KEYWORDS: *Mitigative Building, Mitigative Urban Environment, Mitigation, Adaptation, Microclimate, Passive Strategies, Urban Environment, Policy*



ANALYSIS OF ENVIRONMENTAL COMFORT IN A LIBRARY SCHOOL

ZIEBELL, Clarissa S.
Universidade Federal do Rio Grande do Sul

BERTOLETTI, Roberta, FRANCA, Tailan R.
Faculdade da Serra Gaúcha

Library

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

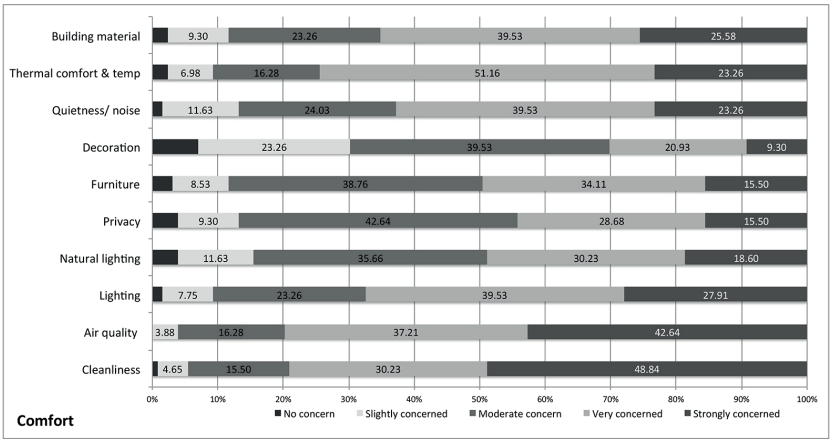
The purpose of this article is analyze a school environment in order to investigate which are the alternatives to improve local comfort conditions. The school selected was the State Elementary School Dante Marcucci (figure 1), located in Caxias do Sul, Rio Grande do Sul. It were investigated three aspects of environmental comfort: heat, light and acoustic. The assessment methodology consisted of questionnaires (answered by students, faculty and staff), computer simulation (through the EnergyPlus and DIALux software, used in the study of thermal and lighting comfort, respectively) and measurements of the noise level.
With regard to thermal comfort, the simulation results showed that the discomfort occurred in the library is for cold. Regarding the questionnaires, 20% of respondents said they consider the temperature inside the library as comfortable during most of the year. With regard to natural lighting, the simulations showed that it is insufficient. However, the questionnaires revealed that respondents were split regarding satisfaction with the natural lighting. Regarding the acoustic comfort, measurements have shown that the noise level, at most of the time, exceeds the recommendation by the Brazilian standard. In the questionnaires, 65% of respondents considered the amount and the intensity of the noise level as uncomfortable.
These results showed that the environment comfort conditions in the library could be improved. This research will serve as a base to a library improvement project, which will be held in partnership with the school community.

KEYWORDS: *ENVIRONMENT COMFORT, POST-OCCUPANCY EVALUATION, LIBRARY PROJECT.*

RETHINKING GREEN HEALTHCARE DESIGN: CRITERIA, CONSIDERATIONS AND CONCERNS IN DESIGNING PUBLIC HOSPITALS IN THAILAND

Sutida Sattayakorn, Masayuki Ichinose
Tokyo Metropolitan University

Yuji Matsuda
The University of Tokyo



Local concerns on comfort in Thai public hospital

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The green concept has recently been introduced to healthcare facilities, mainly because it promises to alleviate energy consumption and improve human health. Although green healthcare design has been globally deliberated, it has received little attention in Thai public hospitals. The specific requirements of green healthcare development depend on context. Therefore, this paper considers and clarifies the issues, requirements and design considerations that would realise a green healthcare model in Thailand. The study combines qualitative and quantitative methods. In addition to adopting green design criteria from the literature, we acquired occupant perceptions and stakeholder perspectives on Thai public hospitals via online questionnaire surveys and in-depth interviews. To re-affirm and strengthen our qualitative findings, we investigated the physical performance of a hospital setting in a case study. This research highlighted on the spatial and environmental considerations and human factors. The importance of the identified factors was subjective, and depended on the stakeholder's experience, although human factors are highly important and underlie all other factors. In the Thai context, socio-cultural factors include social and religious supports, and environmental factors include Thailand's tropical climate and insect repellents. In summary, green healthcare design in Thailand requires a wide perspective and the integration of multi-disciplinary factors; its implementation should harmonise certain green design criteria with human health and well-being, humane design and appropriate socio-cultural and local contexts.

KEYWORDS: *GREEN HEALTHCARE DESIGN, DESIGN CRITERIA, PUBLIC HOSPITAL*

GREEN SKINS TO IMPROVE THERMAL CONFORT OF BUILDINGS IN SOUTHEASTERN BRAZIL

Carla Matheus, Fernando Durso Neves Caetano, Lucila Chebel Labaki

LaCAF/FEC/UNICAMP

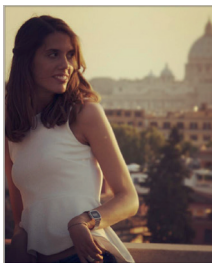
Green wall end green roof used in the comparative experiments.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Worldwide, due to energy crises and the growing demand for energy, passive ways to heat and cool the interior of buildings have increasingly been researched, contributing to energy efficiency. The vegetation possess morphological and physiological characteristics that enable an energy balance with the predominance of latent fluxes, which prevents temperature peaks and promotes passive conditioning of buildings. However, despite its potential for passive mitigation, not always the insertion of large green areas in cities is feasible due the high value and demand for land use. In this sense, the green roofs and walls technologies have the potential to contribute, in a passive way, to improve the quality of environments through the greening of the envelope, thus providing an alternative way to add vegetation in cities with a direct influence on the inner thermal comfort of buildings. Within this context, this study presents the results of two comparative experimental researches conducted in buildings with green skin for the analysis of the new thermal response obtained in the envelope. The studies took place in the climatic reality of southeastern Brazil, in the state of São Paulo, where the thermal mitigation was evaluated. The experiments monitored the outer surface temperatures, and in both cases, the presence of the vegetation led to a better thermal behaviour of the envelopes, when compared to the surfaces without vegetation. In both cases, green skin proved to be effective in controlling the flow of heat through the envelope, providing greater thermal stability to the building, and better conditions for passive thermal comfort for the users of the buildings. Therefore the use of vegetation on the envelope of buildings has showed to be a viable technique to be applied in this region of Brazil.

KEYWORDS: *Thermal Comfort, Green Roof, Living Wall*



NEW LIVING MODELS FOR PEOPLE WITH ALZHEIMER'S DISEASE

Carolina D'Angelo, Germano Schillaci

Architects

image render of the project

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Today we have to face environmental and social challenges at a scale that requires the everybody's attention. Architecture and urban planning must become tools for sustainable and resilient lifestyles, in harmony with local ecosystems and resources. It is therefore necessary to change our approach to the sustainable architecture by analysing people's needs and social-economic trends.

One of the main, but not the only, theme in which European welfare will compete, is population aging. One of the most important consequences of this is the spread of chronic degenerative diseases affecting old people (now more than 8 out of 10) and for which the EU countries annually spend about 70-80% of their investments. What does the aging population require in terms of living arrangements and accommodations?

Architects have a whole new role to play when designing for this growing part of the population. With a set of unique living standards and needs – Architects have to meet new design challenges for seniors, therefore they are inventing fresh blueprints. Careful building planning is a fundamental aid in the care of people with dementia. This work is a contribution to the extremely relevant theme of the special homes for people with Alzheimer. The objective is to provide a starting point that will make people think about the problems connected to designing spaces planned for patients and highlighting the ways in which these challenges can be carried out. Research on the environmental characteristics, the specific environments for different activities, the studies on the organization and the building of spaces, follow the principles of the environmental design, highlighting its benefits. We trust that this work will contribute to improving of the design of these buiildings.

KEYWORDS: *AGING POPULATION ALZHEIMER DISEASE, HEALING ARCHITECTURE, GREEN BUILDING*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Right for a Quality Shelter

2nd Parallel Session

DAY 2

10:30 – 12:30

CHAIRMEN

Alessandro Rogora ..... Table 1
Alberto Bruno ..... Table 2
Chiara Tonelli ..... Table 3

MONITORED ENERGY AND ENVIRONMENTAL PERFORMANCE IN NEW LOW ENERGY HOUSING FOR OLDER PEOPLE IN SCOTLAND

Tim Sharpe

Mackintosh Environmental Architecture Research Unit

View of south façade two-story terraced houses

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The drive to reduce energy consumption is leading to range of new standards, designs, materials and technologies being used in contemporary buildings. At the same time, changes in demography and lifestyle affect how people occupy buildings. Occupants are both the subjects and participants of what are effectively a series of experiments. To learn from these it is vital that we go back and evaluate the performance of these buildings. This paper describes the results of a 2-year Building Performance Evaluation project of three low energy houses for older people in Glasgow, Scotland. Older people are an increasing demographic, with particular environmental demands and patterns of occupancy. The study has found that whilst warm and dry conditions are prevalent, and occupants have high levels of satisfaction, there are some performance gaps emerging in terms of both energy consumption and indoor air quality. Energy consumption is higher than predicted. Some technical defects were found, including problems with active systems such as the solar thermal system and building fabric including detailing and insulation. Achieved demand temperatures were in some cases very high, beyond comfort levels. The study also found evidence of high CO2 levels internally, with a specific concern over ventilation in bedrooms overnight. The key resolution is to ensure that Building Performance Evaluation becomes mainstream practice to develop feedback loops into design.

KEYWORDS: *Housing, Older people, Occupants, Energy, Ventilation, Performance*

UPPER LAWN PAVILION: AN ENERGY ASSESSMENT OF ITS INVISIBLE RESTORATION

-Rocío Escandón - Instituto Universitario de Arquitectura y Ciencias de la Construcción (IUACC), Escuela Técnica Superior de Arquitectura (ETSA), Universidad de Sevilla
-Rafael Suárez, Juan José Sendra
IUACC, ETSA, Universidad de Sevilla.

Upper Lawn Pavilion.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Alison and Peter Smithson incorporated a new sense of environmental responsibility into their architecture, which was more sensitive to climate and energy resources, by integrating the use of passive conditioning systems. The best example of this is the Upper Lawn pavilion as it was both their holiday home and a laboratory in which to prove that "solar heat can be obtained most of the year round and that its build up can offset heat loss". Comfort deficiencies were detected in the pavilion after analysing the energy behaviour of the pavilion in its original condition.
A careful restoration carried out by Sergison Bates Architects in 2003 attempted to resolve these deficiencies after the Smithsons had left the pavilion. As the Upper Lawn Pavilion is classified as a Grade II listed building, this restoration project respected its original exterior and interior appearance. The restoration work improved the insulation of the envelope and the glazing airtightness, as well as incorporating a new general active thermal conditioning system into the building in the form of radiant floor and ceiling heating. This research aims to analyse the energy behaviour of the Upper Lawn pavilion following the 2003 restoration. The methodology applied makes use of the comparison of results of energy simulations carried out using DesignBuilder software for the original and restored models, to highlight the benefits and drawbacks resulting from the measures implemented in the restoration. It is concluded that the restoration noticeably improves the environmental behaviour of the pavilion in winter, while thermal behaviour in summer is worsened. In any case, it is considered a clear point of reference for the necessary environmental and energy restoration of major examples of Modern Movement.

KEYWORDS: *CLIMATE AND RESTORATION, BUILDING AND ENVIRONMENT, SMITHSONS, SOLAR PAVILION, ENERGY SIMULATION.*

OFFICE CLOTHING AND ITS EFFECT ON THERMAL COMFORT AMONGST OFFICE WORKERS IN HOT-HUMID CONDITIONS: A CASE STUDY OF OFFICE WORKERS IN NIGERIA

Meshack O. Efeoma, Ola Uduku

University of Edinburgh (ECA–ESALA)

Examples of office clothing worn by staff of FRCN (left) and FRSC (right)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

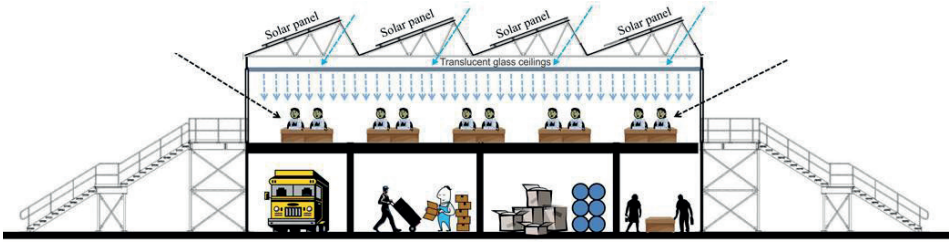
This paper reports on what effect the wearing of regulated office clothing, or official uniform, by administrative staff in the city of Enugu, in Eastern Nigeria, has had on staff perceptions of thermal comfort. This has been achieved by the analysis of the results of field studies conducted in offices of two different establishments in Enugu, Nigeria. The initial results from the field research work suggest that at the office with a strictly regulated clothing policy workers were less comfortable in the same temperature range, when compared to those working in offices with a more flexible approach to work clothing. The paper, therefore, recommends a change in office dress code policy by office management for office workers in the tropical West African climates. Such changes in office lifestyle and people's need will allow for some flexibility of adjusting or adapting office clothing to prevailing thermal conditions. This, in turn, will reduce reliance on mechanical form of ventilation which are expensive to run and maintain in an economy which rely mainly on backup power supply.

KEYWORDS: *Enugu, hot-humid climate, office clothing, thermal adaptation and perception.*

GREEN DAYLIT INDUSTRY FOR DHAKA: AN EVALUATION OF INTEGRATED SKYLIGHTS AND SOLAR PANELS FOR RMG FACTORY BUILDINGS

Md Ashikur Rahman-Joarder, Md. Nahid-Iqbal

Dept. of Architecture, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh.



Concept of green daylit industry for Dhaka, Bangladesh.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Recent safety assessment on existing ready–made garment (RMG) factories in Bangladesh, has explored the necessity for quick shifting of approximately 46% of factories from converted and shared buildings to new buildings. This is an opportunity for Bangladesh to construct new green factories, proficiently. Following the principle of the energy pyramid, this paper proposes a concept for green daylit industry with maximum possible utilization of the sun power, where simple and less cost options were tried first (i.e., skylights in RMG roof structure for daylighting), before pursuing the more complicated and costlier options of renewable energy (i.e. installation of photovoltaic (PV) panels for electricity production) (Fig 1). A dynamic annual Climate-Based Daylight Modeling (CBDM) method considering all weather sky luminance model (i.e. DAYSIM), was used to identify the most feasible skylighting configuration for industrial roof to incorporate maximum useful daylight in luminous environment of the production spaces. To integrate the PV panels to skylight system, effectively, further simulation analysis was done to refine the design parameters, e.g. slope of the skylight, width and spacing, for the most feasible skylight configuration, to achieve highest electricity production round the year. Initiatives were taken to improve the thermal and visual comfort, and aesthetic quality of the interior and exterior of RMG buildings. It is expected that the outcomes from this research will help to guide the development of green daylit RMG factories, in context of Dhaka, to increase productivity of workers and save energy for lighting purpose in RMG sector.

KEYWORDS: *GREEN INDUSTRY; DAYLIT RMG; USEFUL DAYLIGHT; CBDM; DYNAMIC METRICS; PHOTOVOLTAIC; BIPV.*

ACHIEVING THERMAL COMFORT FOR A SLUM REHABILITATION HOUSING SCHEME USING NATURAL VENTILATION IN MUMBAI , INDIA

Ar. SHEETAL PIKLE
Associate Professor, ADITYA COLLEGE,MUMBAI

Ar. MEENAL SUTARIA
Managing Director , GREEN ANGLE ,MUMBAI

Slum Rehabilitation Scheme Building.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Mumbai being in the warm and humid climatic zone, is characterized by high temperature and high humidity throughout the year. Wind aided ventilation and heat removal with simultaneous reductions in indoor air temperatures are some of the most effective strategies. Microclimate also plays a significant role in accelerating or decelerating the comfort conditions.

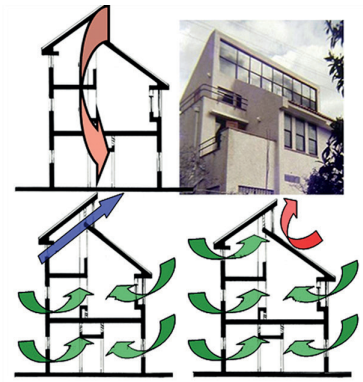
To protect the interest and provide a hygienic accommodation for 55 % of Mumbai's population, living in slums (Ref 1), Government of Maharashtra had developed a Slum Rehabilitation Authority (SRA) Scheme. Under this scheme the developer provides the slum dwellers an accommodation, in lieu of a sale component which they are allowed to develop on the same plot for their profit. This provision by authorities has led to a higher development density within the plot, necessitating a compact planning which may lead to the compromised comfort conditions of the occupants. The Aim of the study is to establish the Thermal Comfort range of the occupants in a naturally ventilated Slum Rehabitation Authority scheme in western suburbs of Mumbai. This study also aims to understand the effect of orientation and openable size of an external fenestration on the thermal comfort of the occupant. The study was conducted by field research. Simulations studies were carried out to improve upon the same. These studies were conducted to study the effect of air - changes and building materials on the micro climatic conditions within the space. Seven building typology was studied and a matrix was used to identify various different planning parameters of solar passive design. The building with least planning and solar passive features was identified for further studies, to determine the solutions which will lead to improve the comfort conditions of the occupants.

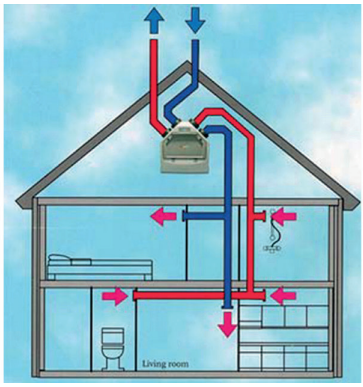
KEYWORDS: *SRA Building Naturally Ventilated Building.*

PASSIVHAUS VS. PASSIVE SOLAR - WHAT IS BETTER FOR THE ISRAELI MEDITERRANEAN CLIMATE?

Abraham Yezioro, Daphna Drori, Edna Shaviv

Faculty of Architecture - Technion IIT





Passive and Low Energy Architecture (Shaviv, 2011) vs. PASSIVHAUS (SEI, 2007)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

We question the assumption that a super insulated and airtight envelope fits the Israeli Mediterranean climate conditions and in particular the affordable apartments for middle class tenants. Moreover, we wonder if the PASSIVHAUS standard should be adopted in Israel, as suggested lately by some experts in the country, or is it better to follow the Passive and Low Energy Architecture (PLEA) principles, on which the Israeli standards SI5281 ("Sustainable Building") and SI5282 ("Energy Rating of Building") are based on? To answer the above questions several simulations for a typical multifamily residential building block located in Israel were performed. The block is placed in the hot humid Mediterranean climate of Tel Aviv and in the cool moderate mountain climate of Jerusalem. The data of the examined building type is based on the requirements of the Israeli Standard SI5282-1 for Energy Rating of Residential Buildings. This standard recommends insulating the building much less than the PASSIVHAUS standard requirements- based on energetic and economic considerations. The results show that for both climate conditions, providing extra insulation and airtight envelope beyond the Israeli standard SI5282-1 Level A recommendations save only very little amount of energy. While it reduces the amount of energy for heating, it increases the energy required for cooling. However, such super heavy insulated walls are very wide and reduce the net area of the flat, which for affordable housing projects are small anyhow. Moreover, since such walls are very expensive it might become unaffordable to middle class residents. Furthermore, increasing the airtightness may cause moisture and mold problems, which create unhealthy buildings, in particular in the hot humid climate of Tel Aviv.

KEYWORDS: *Passive Solar, Low Energy Buildings, PassivHaus, Mediterranean Climate, Sustainable Building Standard, Multifamily Residential Building*

THE FIRST PASSIVHAUS IN QATAR: INITIAL MONITORING AND MODELLING ENERGY PERFORMANCE

May Khalfan, Prof Steve Sharples - University of Liverpool
Dr. Alexander Amato, Dr. Cynthia Skelhorn - Qatar Green Building Council
Dr. John A. Bryant - Texas A&M university in Qatar

Passivhaus villa (PHV) (right) and standard villa (STV) (left)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

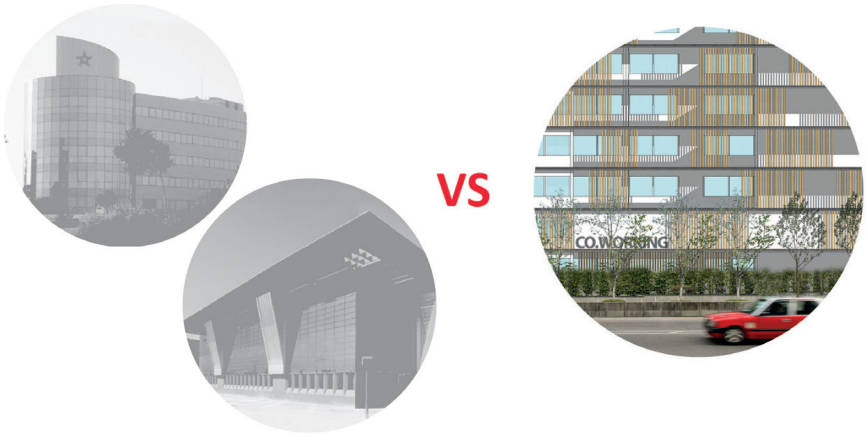
Buildings, by virtue of the energy they consume, have the biggest impact on the natural environment, and the price, availability and by-products of energy create societal and economic challenges in areas such as health and fuel poverty. Consequently, the key architectural solution to these challenges is to create buildings that are just as energy-efficient as possible. This message is especially important for parts of the world, such as countries of the Middle East, which have previously not embraced sustainable, low energy building standards. This paper describes an initiative to demonstrate the viability of such an energy standard (Passivhaus) in the Middle East. The Passivhaus standard was initially developed in Germany in 1990, with the main aims of reducing energy consumption and maintaining a comfortable indoor temperature all year round. The success of Passivhaus has stretched beyond Germany, although only around 100 Passivhaus projects have been realised outside of Europe. Qatar, a country in the Arabian Peninsula, launched its first Passivhaus Project in 2013. The estimated energy performance and comfort levels obtained through the IES dynamic simulation tool indicated that the building would successfully operate under the hot and arid climate of Qatar, and in accordance with the Passivhaus standards. To validate results obtained through modelling, the Qatar Passivhaus has undergone monitoring since its completion. This paper presents the initial findings of the Passivhaus project in Qatar, exploring the actual energy consumption and comfort levels achieved to date. Comparison between the modelled and monitored data have been made, revealing the actual performance of this Passivhaus standard dwelling in a hot and arid climate.

KEYWORDS: *Passivhaus standard/ Energy efficiency/Hot and arid climate*

RE-ACTIVATING THE COURTYARD TYPOLOGY FOR WORK ENVIRONMENTS IN MEDITERRANEAN REGIONS

Maria Lumbreras Arcos, Simos Yannas

AA SED Sustainable Environmental Design, Architectural Association School of Architecture, London.UK



Contemporary work environments in Seville.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Transitional spaces such as courtyards, balconies and galleries, are semi-outdoor spaces with the potential to influence environmental conditions in adjacent indoor spaces. Being powerful microclimatic modifiers, these spaces have always been among the most important tools of vernacular architecture around the Mediterranean region. In the past, they combined with multilayered buildings skins that provided diverse adaptive opportunities for occupants to achieve their personal comfort conditions. By contrast contemporary design of work environments in Southern Spain leads with fully glazed facades disregarding the warm conditions and strong sunshine prevalent in this part of the country. This practice has resulted in high energy demand for air-conditioning often accompanied by thermal discomfort of occupants who have no control over their environment.

The aim of the research presented in this paper was to investigate the environmental potential of the traditional Mediterranean courtyard typology as this architectural element might apply to the contemporary office environment. Fieldwork and environmental measurements taken in recent buildings in Seville served to calibrate a simulation model using EDSL Tas dynamic thermal simulation software. Variants of the model were then run starting from a fully glazed office building as base case, followed by a series of progressive design improvements involving transitional spaces and passive strategies relating to the building envelope and its elements and components. A subsequent round of simulations focused on determining the proportions and materiality of courtyard openings to the plan of an office building.

KEYWORDS: *Summer comfort, cooling, office building, courtyard typology, vernacular architecture, thermal simulation, energy consumption.*

SUN SPACES
A RETROFIT STUDY FOR BUCHAREST

Alexandra Andone, Simos Yannas

Architectural Association School of Architecture

Sunshine penetration for sun catchers during winter (left) and summer (right)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

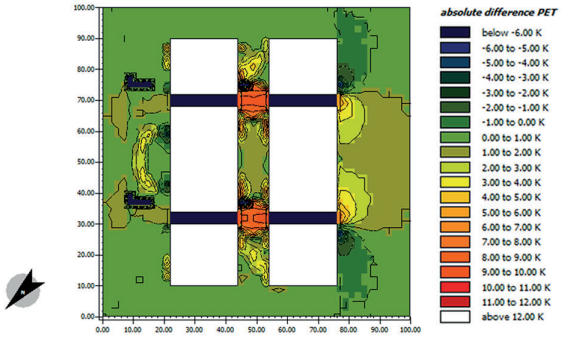
Bucharest, a post-war city which accommodates most of its population in industrial peripheral neighbourhoods has long, cold winters for which its buildings are inadequately designed. As a consequence, fuel poverty affects more than 10% of the city's population each winter. These issues reveal the stringent need for the buildings to be upgraded. The high heating energy bills which are being enforced to the residents do not relate to their actual consumption needs, but to very poor building performances. Being able to achieve thermal comfort indoors during winter should be translated into a demand for performance from the building and not a financial based limitation. However, strong winter sunshine overlapping with low external termperatures revealed an opportunity for passive solar strategies to be explored as architectural tools for sustainable environmental design. The paper summarises key design guidelines obtained from a detailed study that took account of urban density, built form and building envelope properties.

KEYWORDS: *PASSIVE SOLAR DESIGN; SUN SPACES; REDUCED HEATING ENERGY DEMAND; SUSTAINABLE REFURBISHMENT.*

MICROCLIMATE DEVELOPMENT AND COMFORT IN URBAN CANYONS IN RELATION TO ORIENTATION AND ASPECT RATIO; EXPLORING GUIDELINES FOR URBAN DESIGN REGULATIONS

Angeliki Chatzidimitriou, Kleo Axarli

Aristotle University of Thessaloniki



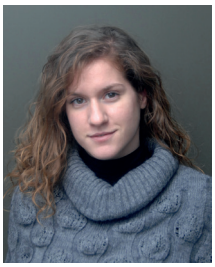
Potential summer comfort improvement at pedestrian level by generic design intervention in an unfavourable canyon configuration (side openings in a deep NW-SE canyon)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The effects of urban development on microclimate conditions has been largely explored in the last decades and despite the high implications on both building energy demands and pedestrian thermal comfort, urban planning and construction legislation has not yet incorporated the research outcome, in the form of specific regulations. Design effects on microclimate have been highlighted in many urban spaces such as squares, parks, courtyards and urban blocks, through simulations and case studies. This study considers the street canyon, as the basic urban unit, and attempts to explore the interrelationship between canyon geometry and orientation, aiming to interpret results into guidelines to inform future regulations. Based on microclimate simulation studies with ENVI-met v4, canyon orientation is examined in relation to aspect ratio taking into account summer and winter conditions in the temperate climate of Thessaloniki in northern Greece (latitude 40oN). ECOTECT software is also used to examine annual solar exposure and shading of building and street surfaces. The results reveal microclimate differences among canyons as well as unfavourable combinations. With focus on outdoor comfort, measures are suggested to offset the geometric deficiency, in the form of guidelines for the considered climate. Although microclimate and outdoor comfort is highly site specific, general guidelines may provide basic principles and allow further improvement with locally focused details.

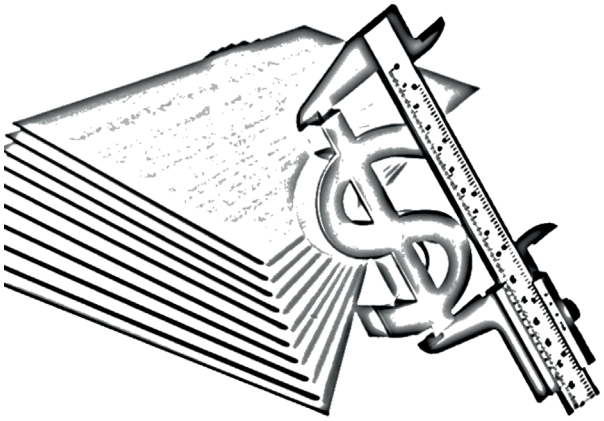
KEYWORDS: *STREET CANYON GEOMETRY, URBAN MICROCLIMATE, OUTDOOR THERMAL COMFORT*



COST OPTIMAL LEVELS OF MINIMUM INSULATION REQUIREMENTS FOR GREEK MULTI - FAMILY HOMES

Eleftheria Touloupaki, Theodoros Theodosiou

Aristotle University of Thessaloniki



Cost - optimal insulation thickness equals adequate thermal protection with reasonable investment costs.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Two years after the implementation deadline of the EPBD recast (Directive 2010/31/EU), Greece has not yet proceeded to the necessary legislative measures and calculations on minimum, cost-optimal energy performance requirements for buildings. Considering the current economic and social crisis the country is going through, improved energy efficiency of the building stock leads to, much needed, alleviation of energy poverty and inequalities, better health (through comfortable and healthy indoor environment) and productivity for the Greek people. On the same time, emphasizing on the energy efficiency of vacant/degraded buildings could make them more attractive and help create new local jobs to boost the economy. This paper aims to identify minimum requirements of insulation that is cost-effective to apply in urban, multi-family, domestic buildings, in the four Climate Zones of Greece. A new "Reference Building" is selected (with pilotis, balconies and four apartment storeys) in order to perform calculations over ten scenarios of increasing (external) insulation thicknesses for each Climate Zone on a basic and 3 sensitivity analysis calculations [European Parliament and Council Directive on the energy performance of buildings (recast) [2010] OJ L153/13]. The official calculation software TEE KENAK is used to estimate the resulting energy savings for each insulation scenario and the cost-effectiveness of the measure is examined in financial and macroeconomic perspective (economic lifecycle of 30 years). The minimum requirements for each Climate Zone arise, for the financial calculation, to 5-7 cm (Climate Zone A), 7-9 cm (Climate Zone B) and 11-13 cm (Climate Zones C and D), while in the macroeconomic calculation, to 7-9 cm. (Climate Zones A and B), 13 to 15 cm (Climate Zone C) and 15-17 cm (Climate Zone D). Divergence between these results (macroeconomic and financial) indicates potential funding gaps that should be eliminated for the effective improvement of energy efficiency in Greek homes.

KEYWORDS: *Insulation, Cost-optimal, Energy Efficiency, Greek homes.*

SELF BUILT MODULE WITH PASSIVE SOLAR FEATURES AND MADE WITH RECYCLED MATERIALS

Alessandro Rogora, Claudia Poggi

Politecnico di Milano

Image of the built module

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The building sector produces a large amount of waste and consumes a significant percentage of environmental resources for building heating, cooling, lighting, etc. The final cost of a building depends on several elements, but it can be divided into three main aspects related to: land cost, cost of materials and cost of human work. The land cost is difficult to control and depends on political choices, while both costs of materials and human work largely depend on design decisions. A project made to minimize construction waste (e.g. that considers the size of blocks in design in order to reduce broken, unused pieces) can save up to 20% of the building materials, while the choice of a building technic rather than another affects the final building cost as well as its ecologic footprint.

The module built at Abbiategrasso - near Milan - represents an attempt to reduce the final building cost both from the economic point of view and in term of ecological footprint. The module has been designed in a master thesis work and it was built by the students of the Building Technology Studio. Both for building structure and insulation, wasted, recovered materials have been used. These solutions largely reduce the ecological footprint of the building, and the attempt to use solar energy for building winter heating and appropriate shading strategies and ventilation for summer cooling complete the sustainable approach.

KEYWORDS: *Self built module, solar wall, reused building materials*

LIGHTING PERFORMANCE IN RURAL VERNACULAR ARCHITECTURE IN CYPRUS: FIELD STUDIES AND SIMULATION ANALYSIS.

Aimilios Michael, Chryso Heracleous, Eleni Malaktou, Andreas Savvides, Maria Philokyprou

University of Cyprus

Buildings under study: in Maroni, Pera Orinis and Askas respectively.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The research presented aims to investigate the natural lighting performance of indoor and semi-open spaces in rural vernacular settlements in Cyprus and to propose solutions to improve the lighting performance of these spaces with respect to their unique cultural character. Specifically, three representative buildings located in different settlements in Cyprus were selected based on their building typology, orientation and components of rural vernacular architecture. Each building is located in a different climatic zone as the topography of Cyprus varies between regions affecting the built fabric. The first case-study is located in the coastal zone, the second case-study in the lowland region and the third case-study in a mountainous region. For the evaluation of the lighting levels of each building, in-situ lighting measurements as well as software simulations were employed. In-situ illuminance data were compared to simulations in order to validate the digital model. The subsequent lighting simulation addressed representative indoor spaces and was performed for an entire year, based on dynamic climatic variations. Simulations were carried out using Ecotect software v.5.2, Desktop Radiance v.2.0 software and Daysim v.3., while the weather files were extracted from Meteonorm v.7.1.3 software. The results of the analysis enabled an evaluation of daylighting in different typologies in the rural vernacular architecture of Cyprus within various climatic zones. Conclusions regarding potential improvements were proposed in the three selected case studies in order to meet the contemporary daylight needs of potential occupants.

KEYWORDS: *Natural Lighting Levels, Field Measurements, Simulation, Static and Dynamic Analysis, Improvements, Rural vernacular architecture, Cyprus.*

THE EXPO 2015 PAVILION: BREATH AUSTRIA OUTDOOR COMFORT IN THE CITY

Martin Engelhardt, Wolfgang Kessling, Alexander Greising

Transsolar Energietechnik GmbH

Vegetation in the pavilion with special developed fan and misting system

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Evapotranspiration is one of the (probably underestimated) elements to mitigate urban heat island effect. Well watered green areas can reduce ambient air and radiant temperatures. Studies estimate that an increase of about 10% of green areas could compensate for the temperature increase of the climate change, 1 ha of lawn can reduce air temperature by about 1 K (Gil. et al, 2007).
The paper is on how to evaluate outdoor comfort and how to design for outdoor comfort in Mediterranean climate. The idea and the concept is showcased by the Austrian EXPO pavilion from May to October 2015 in Milan. The concept is largely based on optimizing passive strategies in combination with evapotranspiration and low-tech adiabatic cooling and elevated air speed. For this a high effective outdoor fan and misting system has been developed and optimized. The methodology to assess and predict the major parameters on outdoor comfort to inform the design is described. First results of measured outdoor comfort are compared with the predictions of the competition phase. The concepts are fully imbedded into the overall concept of the pavilion with its large open and intensive greenery. All public accessible areas are open to outdoors. Further to that the client and team decided to showcase this level of outdoor comfort and to avoid any additional mechanical cooling systems in the entire pavilion. The electrical energy demand will be fully produced by photo voltaic.

KEYWORDS: *OUTDOOR COMFORT, COMFORT MODELING, ADIABATIC COOLING, UTCI, AUSTRIAN PAVILION, EXPO 2015*

STUDY ON THE INDOOR THERMAL ENVIRONMENT OF MULTI-UNIT RESIDENCES IN ASIA

Meinan Wang, Nobuyuki Sunaga Eiko Kumakura, Fu Nakashima, Rei Kuramochi - Tokyo Metropolitan University. Songtao Hu - Qingdao Technological University. Akinori Hosoi - Japan Women's University. Jinghui Ma - Zhejiang Sci-Tech Universit. Haiying Wang - Qingdao Technological University

Field measurement cities in Asia

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

With the rapid development of the economy in Asian countries, energy consumption has also been continuously increasing. In order to reduce energy consumption, energy conservation in buildings is bearing the brunt of this problem. So far, multi-unit residences (apartments) are the main type of home for ordinary families in most Asian countries. However, because of different climate conditions, life styles, and energy consumption ideas, there are wide variations in indoor thermal environments and energy consumption of multi-unit residences in different countries or regions. How to grasp the status of indoor thermal environments and reduce energy consumption in Asia should be given primary importance among priorities. This paper mainly researched the current status of thermal environments in Asian multi-unit residences through literature survey, field measurement and questionnaire analysis. On such bases, rational improvement proposals and measures have been put forward to improve the comfort of indoor thermal environments and energy conservation in Asian multi-unit residences. For example, both thermal adaptation of local people and energy-saving awareness should be considered at the beginning of designing a residential thermal environment. In winter, for the district heated regions, the design heating temperature should be reduced properly according to the thermal adaptation of local people. At the same time, the household heat-regulating system should be put into practice.

KEYWORDS: *Multi-unit residence; Energy conservation; Indoor thermal environment*

PASSIVE TECHNIQUES FOR 24 HOUR WORKING ENVIRONMENTS IN BANGALORE

Shravan Pradeep - AA SED Sustainable Environmental Design, Architectural Association School of Architecture, London, UK
Paula Cadima - Architectural Association School of Architecture, London, UK

View of the Proposed Office Building

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Bangalore is recognized as one of the world's I.T capital, catering to service industries all over the world with offices which function 24 hours round the clock. Current office buildings in the city which has a moderate tropical climate seem to have adopted a "Glass box" approach. This has resulted in an office typology having high cooling demand with little connection to the outdoors, insignificant adaptive controls for the users and monotonous floor spaces creating mundane working environments.

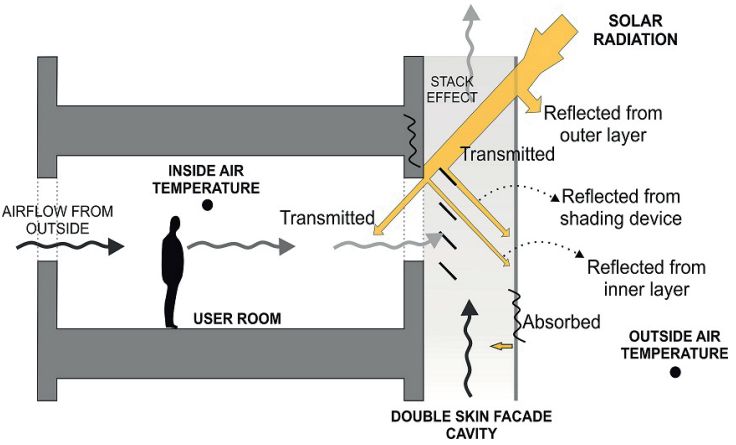
This paper reports on new working environments, where users are engaged to modify and moderate one's habitat according to their needs. This represents a complete shift from conventional working environments to working and living outdoors. Based on a research aimed at developing design guidelines for such a typology, (Pradeep.S.,(2014) Design Strategies for Office Buildings in Bangalore, Architectural Association School of Architecture, London) , a design proposal for Bangalore of an office with villages around a central atrium and social spaces forming the pine of the building is here discussed (Figure 1). These spaces work as buffer 'boxes' between the outside and the central working zones, which are separated with movable screens to create areas with varied daylight levels inside as well as a dynamic façade on the outside.

KEYWORDS: *Offices, Tropical Climate, India, Bangalore, 24 Hour Working Environments*

INFLUENCE OF KEY SITE PARAMETERS ON THE THERMAL PERFORMANCE OF DOUBLE SKIN FAÇADES IN NATURALLY VENTILATED BUILDINGS IN A TROPICAL CLIMATE

Sabrina Barbosa, Dr. Kenneth Ip, Dr. Ryan Southall

University of Brighton



Double skin façade heat transfer and airflow mechanisms

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

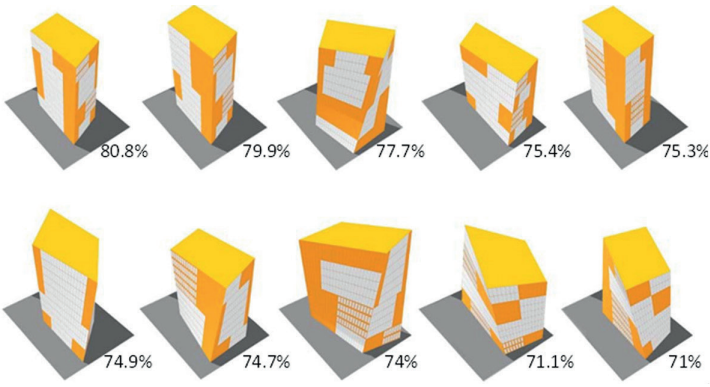
Double skin façades (DSFs) have gained recognition as architectural elements in modern office buildings which, when appropriately applied, can potentially lead to improvements in the indoor thermal comfort and reduction in building energy consumption even in warm or tropical climates. This technology that utilises the renewable resources of solar and wind to reduce the air-conditioning demand in such climates is a potential solution to the current environmental challenges. This study examines the influence of key 'site' parameters, by keeping the 'building' parameters constant, on the thermal behaviour of an optimized building model with DSF. The site parameters represent the variables of two local environmental conditions: the level of local solar incidence, which relates to the influence of hours of the day, solar angle, sky conditions (cloudy and clear) and façade orientation on the building behaviour; and the wind conditions, which account for the effects of speed and direction acting on the DSF. Using the climate data of Rio de Janeiro city as the tropical environmental context, building energy simulations are performed to the defined DSF models. Airflow levels and periods of thermal acceptance, based on the adaptive comfort criteria in relation to the outdoor environmental variations, are analysed to demonstrate the site conditions under which the technology is likely to operate effectively.

KEYWORDS: *DOUBLE SKIN FAÇADE, SITE PARAMETERS, THERMAL PERFORMANCE, NATURAL VENTILATION*

PERFORMANCE-BASED CONCEPTUAL FORM GENERATION USING GENETIC ALGORITHM, A CASE STUDY.

Alaa El-Din Sarhan, Rania Abdel-Galil, Iman El-Badry
Arab Academy For Science and Technology, Egypt.

Khaled El-Deeb
Faculty of Fine Arts, Alexandria University, Egypt.



Performance-based computationally generated building forms. Overall fitness values.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Recent developments of digital design tools created a revolution in building form design. Both building form and envelope design have a major passive role in climatic control, and consequently have an impact on the amount of energy needed to mitigate the unfavourable indoor conditions.

Currently, building performance simulation tools enable prediction of different performance aspects such as energy needed for heating, cooling and artificial lighting as well as the availability of natural daylighting. However, these software tools are usually used to test designs at a relatively late design stage, at which major modifications in building form and envelope designs are unlikely to take place.

This research reports on an experiment investigating the potential of using parametric computation tools to guide form and envelope design generation, using building performance as a design parameter since early conceptual design stage, through a multi-objective optimization process.

The experiment was applied for design of an office building within an urban context in Cairo, Egypt. An evolutionary algorithm was designed to generate and optimize building form based on energy and daylighting performance. The optimization process lasted for 486 hours of continuous simulations, tested 810 trial alternatives of building forms and showed ones of highest scores. Top performing alternatives were derived and analysed.

The experiment showed a shift in the role of architect from design of the building to design of the algorithm with which hundreds of building designs can be generated and optimized to reach the most efficient solutions.

KEYWORDS: *Building Performance; Parametric Design; optimization*

IMPROVING ROOM ACOUSTICS IN OPEN-PLAN OFFICES. TESTING THE RELATIONSHIP OF ACOUSTICAL AND VISUAL DISTRACTION AT WORKSPACES WITH SOUND-MASKING SYSTEMS.

Uta Pottgiesser, Christoph Kirch

Hochschule Ostwestfalen-Lippe

Workspaces in open-plan office are characterized by disturbing sounds and speech noise.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

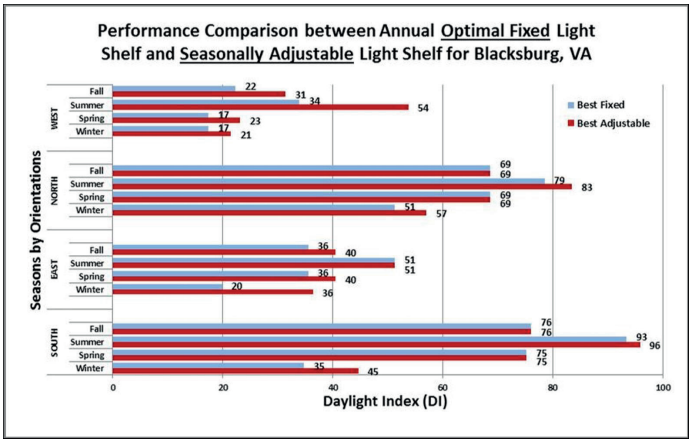
Many workspaces in open-plan offices suffer from high noise levels and undesired transmissions of speech noise between the users. These are leading to increased distraction by irrelevant speech information. This acoustical overall situation has serious consequences for the working environment: concentration- and performance loss as well as impairments of mood and well-being. Surveys on disturbing sounds have proven that human language distracts much more than sounds that are generated by natural sources or technical devices. Especially in times of changing working structures, when flexible spaces promoting interaction gain an increasing importance, room acoustics have to ensure that all negative impairments caused by noise and speech sound are prevented. Different measures and concepts come into question for acoustical optimization: absorption, shielding and sound-masking. Absorption can be achieved by means of acoustically-effective ceilings, floorings or furniture although these singular measures are often not sufficient. Sophisticated sound-absorbing systems are in the market. To reduce disturbing speech information sufficiently, advanced sound-shielding measures between the working areas are required. To efficiently prevent speech-like noise an adaptive sound-masking system in combination with visually adapted shielding elements should be developed, tested and implemented for open-plan offices in the presented research. The studies have shown that the design of these absorbing and shielding elements is a relevant factor as any conformity between spatial design and sound helps to improve the user acceptance. It was further verified by tests that permanent movements in the peripheral field of vision of the test persons were perceived as distracting and annoying.

KEYWORDS: *DISTURBING SOUNDS, SPEECH NOISE, ABSORPTION, SHIELDING, SOUND-MASKING SYSTEMS, SPATIAL GENEROSITY, VISUAL CONTACT, TRANSPARENCY, CONCENTRATION, USER ACCEPTANCE AND WELL-BEING.*

A FRAMEWORK TO SUPPORT THE DEVELOPMENT OF MANUALLY ADJUSTABLE LIGHT SHELVES

Shamim Javed, Georg Reichard

Virginia Tech



Performance comparison between fixed and seasonally adjustable light shelf.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study identifies a promising potential for seasonal, manually adjustable light shelf systems that harvest some of the performance benefits of active daylighting systems and the simplicity and affordability of passive systems. . This hybrid of the two systems can provide higher levels of performance within an affordable solution (Javed & Reichard, 2014). This paper builds on previous work by proposing a framework to support the development of manually adjustable light shelves. The framework is a selection tool that could aid a manufacturer or user to find an optimum manually adjustable light shelf configuration for a given context. The study first developed performance evaluation criteria for manually adjustable light shelves. It then went on to find optimum manually adjustable light shelf configurations for selected cases, using a reduced set of light shelf variables, as a proof-of-concept. The study concludes with an outline of a framework for manually adjustable light shelf selection. The basic steps involved in the making of such a framework and a schematic view of the simulation loop on which the framework rests is presented. The study is part of an ongoing research towards a tool to support the development of manually adjustable light shelf technologies.

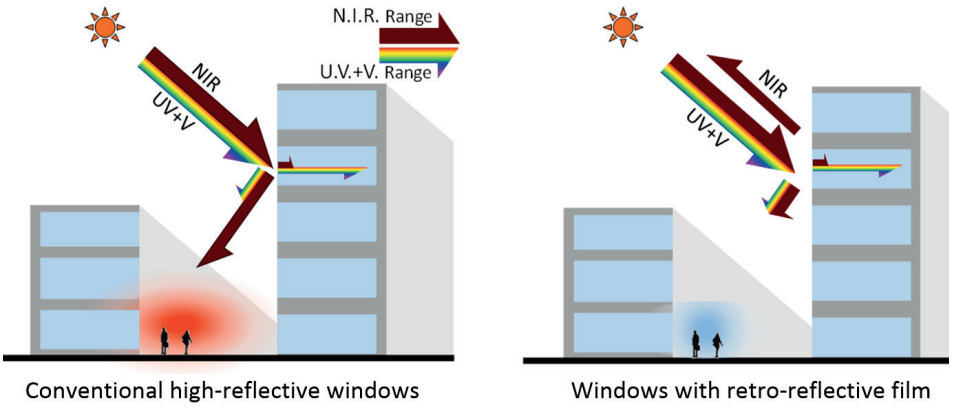
KEYWORDS: *Light Shelf, Daylight Harvesting, Framework Development.*

IMPROVEMENT OF OUTDOOR THERMAL RADIATION ENVIRONMENT IN URBAN AREAS USING WAVELENGTH-SELECTIVE RETRO-REFLECTIVE FILM

Takashi INOUE - Tokyo University of science

Masayuki ICHINOSE - Tokyo Metropolitan University

Tsutomu NAGAHAMA - Dexerials Corporation



Conventional high-reflective windows *Windows with retro-reflective film*

Fig 1: Schematics of retro-reflective film and influence on thermal environment in the street

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The solar-shading performance of a building envelope, particularly in warm or hot countries, is considered to be the most important architectural factor influencing energy conservation. Based on urban street measurements, we observed the impact of conventional high-reflectivity techniques on the thermal environment of areas in the immediate vicinity of buildings equipped with reflecting film or solar-shading type Low-E glass. The results showed that solar radiation in the near-infrared range reflected from the façade of a building significantly degraded the thermal environment of the surrounding streets. To counteract this, we propose a new solar-shading film that is retro-reflective to near-infrared solar radiation. When installed on a building, the film's innovative heat-shielding features makes it possible to effectively return near-infrared solar radiation toward the sky while minimizing secondary effects on other buildings in the surrounding area. In this paper, we report on comprehensive measurements taken in order to investigate the optical properties of the retro-reflective film, and the results of experiments carried out with the film attached to the windows of a building at our university. These results verified the film's optical performance regarding retro-reflectivity and selective transmission/reflection in the visible and near-infrared ranges. We then applied the retro-reflective heat-shielding film to new high-rise building façades in Tokyo, and through year-round measurements, verified the energy conservation performance and reduced adverse effects on the outdoor urban thermal environment.

KEYWORDS:

THE USE OF CREEPER IN BUILDING ENVELOPES AS BIOCLIMATIC STRATEGY FOR SOCIAL HOUSING

Denise Damas de O. Morelli, Lucila Chebel Labaki

State University of Campinas - Brazil

Fig 1: Area of prototypes

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The vegetation is a good natural element to control sunlight and reduce heat gain in indoor environments. Its use provides better conditions of environmental comfort, contributes to energy efficiency in buildings and to reduces pollutant in urban areas. It is a well-known fact that the use of vegetation as second skin in buildings improves thermal environment, due to its shading effects, attenuating incident solar radiation. It is a good bioclimatic solution especially in places that do not allow the planting of tree vegetation. The quality of architectural solutions involving the aesthetic and functional aspects of architectural design, especially in social housing for low-income population, determines the efficiency with which the project meets the needs of family members. In these houses, the use of the creeper on the façade and building coverage is a real possibility of easy access, low cost and simple maintenance. This paper describes an experimental study on green coverage and green wall carried out in the Southeast of Brazil, a region the subtropical climate. The aim of the research is to evaluate the use of vegetation-climbing in test cells and to verify its influence in the indoor thermal environment. The method consists of acquiring data about the thermal performance through measurements on three identical test cells: without creeper, with creeper straight in the wall and creeper over a frame, distant 50 cm from the wall both in the façade and over the roof. The vine species analyzed are Thunbergia Grandiflora (tumbergia-blue) and Jasminum azoricum L. (jasmine-of-azores). The measured parameters were external an internal air temperature, relative humidity, air velocity as well as the surface temperatures inside and outside the wall and roof. Results show that the most sensitive parameter to the use of creeper is the internal temperature, and the best thermal performance was that for the prototype with the creeper in the façade.

KEYWORDS: *THERMAL COMFORT, VEGETATION (CREEPER), BIOCLIMATIC ARCHITECTURE.*

ARCHITECTURAL ENERGY KIT: THE THERMODYNAMIC PARAPET OF "RHOME"

Chiara Tonelli, Stefano Converso

Roma Tre Univesity

view from outside of the Thermodynamic parapet during Public Visits at Solar Decathlon 2014

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Architectural integration of components for renewable energy production is a relevant topic in current market and research. Despite of National Codes encouraging practices of integration and efforts by designers, too often systems are still left to technicians, and hidden in "invisible" areas of buildings such as basement, roofs, as much as possible. These areas are increasingly large and architecture should reconsider this solution by addressing towards a much deeper integration between systems and buildings. This paper deals with the Building Integration by describing the process of design, optimization, engineering and production of a "thermodynamic parapet" for the production of domestic hot water transferred to architecture from the refrigeration industry. Originally conceived and prototyped for the "Solar Decathlon" competition the project is developed as an autonomous system, according to the idea of an "energy kit": a localized intervention that points to existing contexts to empower them, in performance, and with a new architectural image.

KEYWORDS: *THERMODYNAMICS, DOMESTIC HOT WATER, ARCHITECTURAL INTEGRATION, ENERGY EFFICIENCY*

A THOUSAND EXPERT OPINIONS IN ONE EXPERIMENT – CONNECTING THE DOTS IN A EUROPEAN PROGRAMME

Lone Feifer, Peter Foldbjerg, Jens Christoffersen

VELUX Group

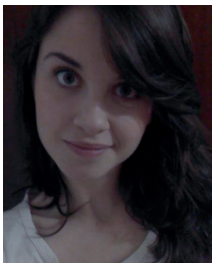
users as pivoting point

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Sustainable buildings should support people´s health and wellbeing
In historical terms, the current concept of dwelling is extremely novel. During our lifespan we spend 90% indoors, sheltered from the elements, safely moored in a controlled environment for our comfort and welfare. Yet our bodies have not altered one bit since we went shopping with a spear and dozed under the open sky. In essence, we are still adapted to life outside rather than inside. The model home 2020 programme of 6 demonstration projects across Europe bases on the assumption that sustainable living can be achieved in an indoor environment that prioritises natural living conditions. One essential target is to recreate the nurturing properties of an outdoor experience without compromising the need for heat and shelter. Discoveries from the post occupancy evaluation and monitoring of the model homes confirm that access to more daylight and fresh air has a positive impact on the inhabitants' wellbeing and even a direct beneficial effect on asthma and allergies.

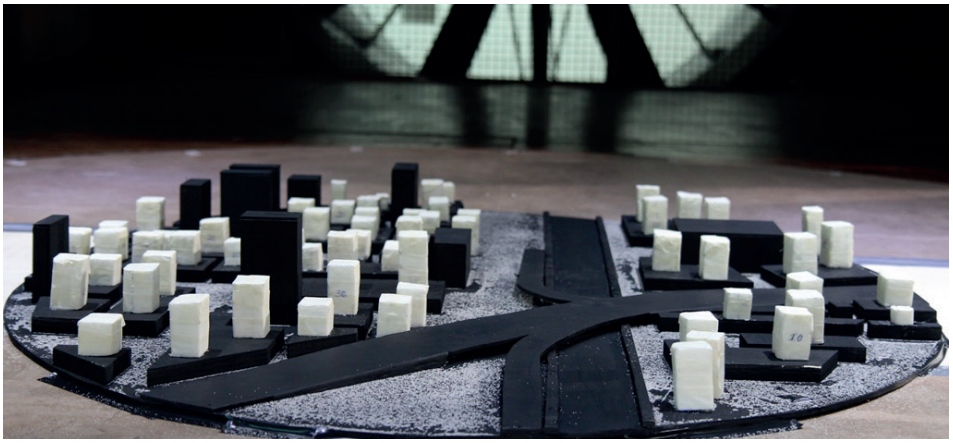
KEYWORDS: *Model Home 2020, Active House, innovation by design, healthy homes and buildings.*



CONSEQUENCES OF VERTICALIZATION

Paula Bregiatto de Oliveira, Roberta dos S. Astigarraga
Instituto de Pesquisas Tecnológicas and FATEC Tatuapé

Gabriel Borelli Martins, Paulo José Saiz Jabardo, Gilder Nader – Instituto de Pesquisas Tecnológicas



WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Verticalized neighbourhoods result in the optimization of plot areas. However, verticalization may also result in poor environmental conditions such as heat islands and accumulation of pollutants. Master Plans guide the development of a city while trying to minimize these issues. These plans specify a parameter called exploitation rate, which is a coefficient that, when multiplied by total area of the land, results in the allowable constructed area. In July 2014 the 2002 Master Plan of São Paulo was updated, and the maximum exploitation rate in some regions was reduced from 4 to 2. To verify the effects of verticalization according to both Master Plans and the current situation, an area of the city was studied numerically and experimentally. The area is in the vicinity of FATEC Tatuapé, a neighborhood that is undergoing this urban process. This area is completely paved with very little vegetation which contributes to the formation of heat islands. Sand saltation technique was used on a 1:500 scale model, simulating the current situation and both the 2002 and 2014 Master Plans. Numerical modeling was carried out using the ENVI-met 3.1 software, simulating the same region. The experimental and numerical modeling present very similar results that show that further verticalization will be harmful even though the newer Master Plan is an improvement.

KEYWORDS: *Verticalization, heat islands, wind tunnel*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Right for a Quality Shelter

3rd Parallel Session

DAY 2

14:00 – 16:00

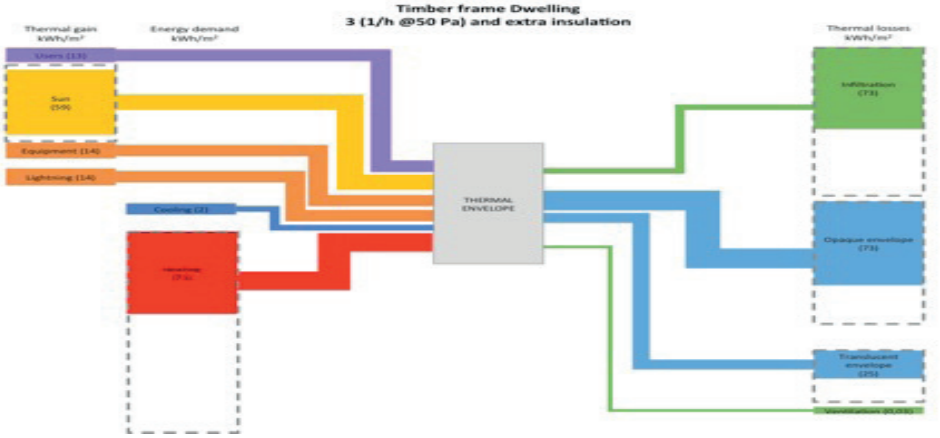
CHAIRMEN

Rajat Gupta ..... Table 1
Niccolò Aste ..... Table 2
Werner Lang ..... Table 3

THE IMPACT ON ENERGY DEMAND OF NEGLECTING TO CALCULATE THE ENERGY LOSS DUE TO AIR LEAKAGE

Muriel Díaz, Ariel Bobadilla, Carolina Recart

CITEC UBB, Universidad del Bío-Bío, Concepción, Chile



Energy balance of timber frame dwelling presenting demand with 3 (1/h @50Pa) compared to original dwelling with 20 (1/h @50Pa).

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Recent research shows that a high percentage of the energy losses of dwellings in Chile are produced by the lack of airtightness of dwellings in (Figueroa et al., 2013). This research evaluates the impact on energy demand of improvements applied to air tightness and thermal transmittance, based on the analysis of the energy balance of two typical dwellings in Concepcion, Chile by using simulations with thermal transmittance and air leakage parameters acquired by measurements and on a second step, four levels of improvements on both, airtightness and transmittance parameters in order to evaluate the interference of these on demand and to select an improvement that allows reaching an acceptable energy demand.

It is concluded that energy demand is strongly affected by air infiltration in both cases of study, which means that miscalculating the energy losses by infiltration can overlook up to 24% of the energy demand in the cases studied. To address more energy efficient dwellings, it is recommended to, as a first strategy, improve the airtightness of the envelope. Although a substantial decrease on energy demand is only possible by combining airtightness and better thermal insulation of the dwellings.

KEYWORDS:*Dwelling, Air infiltration, Air leakage, Energy Demand, Chile, energy balance.*

SUSTAINABLE MATERIALS: AN EMPIRICAL STUDY ON THE THERMAL PERFORMANCE OF PLASTIC-BOTTLE-WALLS

Fiona Naoum, Bakr Gomaa, Gihan Mosaad

AASTMT, Alexandria, Egypt

Bottle walls building Process

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A sustainable material achieves a number of goals; they promote ecological protection, low pollution, and conservation of resources. This is achieved through some characteristics; three of which are; low waste, local sourcing, and thermal performance. The current construction industry dynamics is embracing the use of non-sustainable materials; this is clear in the rare occasions in which bottle buildings are constructed throughout the world. In fact they are only sought in poor regions with no access to high technology, or very rarely in modern cities. This has led to shortage of information, and very rare thermal performance assessments of low-tech construction generally, and plastic bottle-walls specifically. This research discusses empirically the thermal performance of sand filled plastic-bottle-walls in the Mediterranean climate of Alexandria (Egypt). Methods include literature review, and a case study test in which a chamber is constructed in the outskirts of Alexandria. The chamber walls are constructed of used plastic bottles, filled with locally sourced sand. The Research shows that sand filled plastic bottles have great thermal delay that averages over 6 hours, and promote a cooler indoor environment.

KEYWORDS: *Plastic bottles, Building with re-used bottles, Thermal performance*

DEVELOPING SUSTAINABLE DESIGN STRATEGIES FOR NURSERY BUILDINGS IN MEDITERRANEAN CLIMATE

Sofia Ilia, Polytimi Ilia, Georgios Alexandrou

ILIA SOFIA & PARTNERS

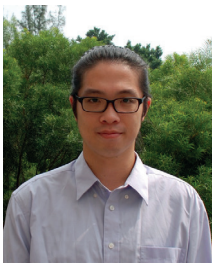
Built project. North-west view. Nursery in Attica.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The research starts with a general discussion of the special demands that school buildings have in terms of energy consumption, due to their volume and occupancy schedule. In particular, the study focuses on cases related to the Mediterranean region, and even more specifically in Attica, Greece. The case study refers to a nursery school with capacity of 108 children and 20 infants, located in Aspropyrgos, a lowland town in Attica. The research aims to create an energy efficient school building responding to the local climatic conditions. Through deliberate research and analysis, in the form of daylight and thermal simulations, numerous conclusions will be drawn with regard to a vocabulary of sustainable methods mainly including passive environmental strategies. These strategies aspire to constitute a prototype for school buildings with high energy demands in this particular climate. In accordance with the final outcome of the research, the initial hypothesis of the paper will be verified. More specifically, it will be concluded that new nursery buildings can be designed using a vocabulary of sustainable strategies, constituting an architectural prototype that can in fact reduce building's energy consumption, in a Mediterranean climate. The findings of this research and practice will be useful references for architects and environmental engineers in the field of sustainable design, contributing to the development of an environmental toolbox regarding to new nursery buildings.

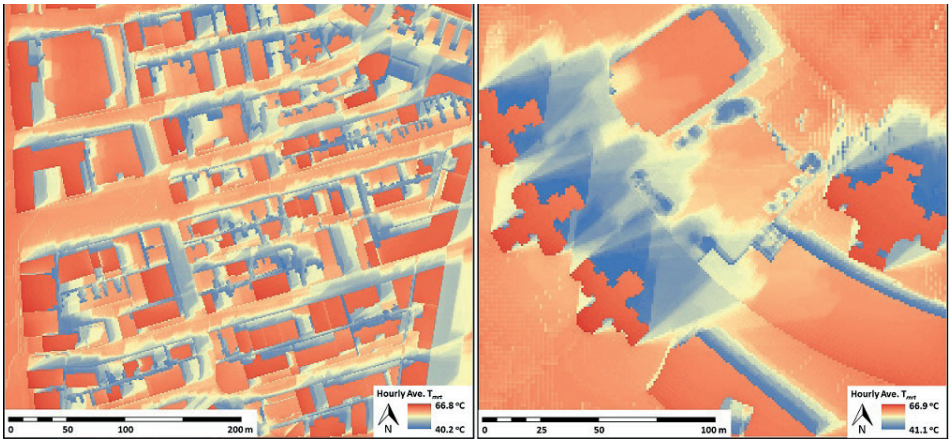
KEYWORDS: *NURSERY; BUILDING OF HIGH ENERGY DEMANDS; OCCUPANT COMFORT; SUSTAINABLE STRATEGIES; ARCHITECTURAL PROTOTYPIC TYPOLOGY; MEDITERRANEAN CLIMATE.*



SPATIAL DISTRIBUTION OF OUTDOOR HEAT STRESS UNDER HEATWAVE CONDITIONS IN SUB-TROPICAL HIGH-DENSITY URBAN ENVIRONMENT

Kevin Ka-Lun Lau, Chao Ren

The Chinese University of Hong Kong



Spatial variation of Tmrt under heatwave conditions (daily maximum air temperature above 33oC).

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

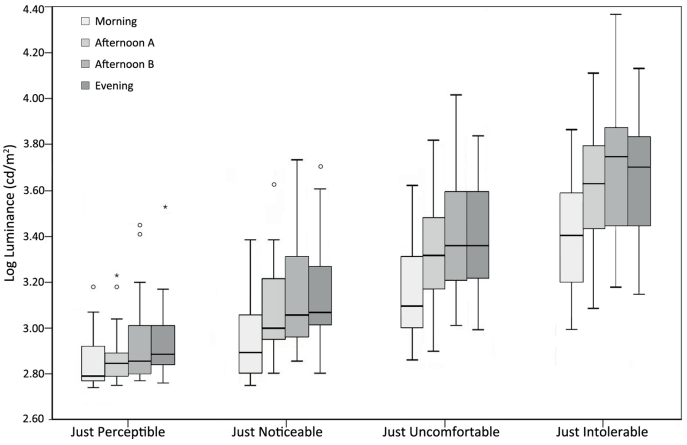
The magnitude and frequency of heatwaves are expected to increase in the future due to the effect of climate change. Such an enormous thermal load will be further intensified due to the effect of urban structures and results in thermal discomfort or heat stress to pedestrians. One of the design solutions is to provide shading to pedestrians through increasing building height and density as well as vegetation such as street trees. In sub-tropical high-density cities like Hong Kong, tree planting is generally limited due to the limited availability of land. It is therefore important to identify areas which experience the most intense thermal load (i.e. hotspot areas) for the implementation of mitigation measures. In the present study, the spatial distribution of outdoor heat stress, using mean radiant temperature (Tmrt) as an indicator, is identified using the SOlar and LongWave Environmental Irradiance Geometry (SOLWEIG) model under heatwave conditions. Field measurements of three-dimensional radiation fluxes are used to evaluate model performance. It is found that the model is generally successful to capture the diurnal variation of both shortwave and longwave radiation within complex urban environment. The resultant Tmrt modelling shows that high radiant thermal load is confined to south-facing façades of buildings and open spaces. There are also considerable differences in radiant thermal load between various street orientations. Vegetation is found to be effective in reducing radiant thermal load since Tmrt is 8-19oC lower in areas shaded by vegetation. Findings of the present study suggest that mitigation measures such as using shading of buildings and vegetation should be adopted in areas with high radiant thermal load in order to maximize its shading effect. For locations with limited spaces, artificial shading devices such as arcades and extended canopies from buildings are recommended.

KEYWORDS: *Heatwaves; heat stress; mean radiant temperature; SOLWEIG*

TIME OF DAY, TEMPORAL VARIABLES AND PERSONAL FACTORS IN THE SUBJECTIVE EVALUATION OF GLARE SENSATION

Michael Kent, Sergio Altomonte, Robin Wilson
The University of Nottingham

Peter Tregenza
The University of Sheffield



Boxplot of Log Luminance for different Glare Sensation Votes

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Several indices have been developed to predict glare sensation. However, if different subjects were asked to express their perception of visual discomfort from various light sources characterised by similar glare indices, a large spread of data would likely appear. This suggests that there must be other variables that influence the level of visual discomfort other than those typically embedded in glare formulae (source and background luminance, source size, position index). Various studies have looked at how light influences the perceptual and metabolic system at different daily periods. Based on these results, to test whether a relationship exists between time of day and glare sensation, thirty subjects were exposed to an artificial lighting source at four test sessions. The source luminance was progressively increased and subjects were required to give Glare Sensation Votes (GSVs) based on the level of visual discomfort perceived. Statistical analysis of data revealed a tendency towards greater tolerance to luminance increases as the day progresses (Fig. 1). This trend was found not to be affected by learning. During the tests, temporal variables and personal factors were also measured to analyse their influence on the reported glare sensation. Inferential testing revealed a statistically and practically significant tendency towards greater tolerance to source luminance for earlier chronotype subjects and for participants not having ingested caffeine. No conclusive evidence was found for the effect of fatigue, sky condition, and prior light exposure on glare sensation Synthesising research by the authors, this study suggests that time of day, temporal variables and personal factors should be measured together with GSVs to explore the causes of scatter commonly associated with the subjective evaluation of glare sensation, and increase the predictive power of glare indices.

KEYWORDS: *Glare Sensation, Time of Day, Temporal Variables, Personal Factors.*

DEVELOPING VALUE ADDED SOLUTIONS FOR A LOW GRADE TIMBER RESOURCE

Paul Attea, Ted Shelton - University of Tennessee, College of Architecture and Design
Dr. Jennifer Q. Retherford - University of Tennessee, College of Civil and Environmental Engineering
Dr. Adam Taylor - University of Tennessee, Center for Renewable Carbon

The modular 'bent' system [A], a bent assembly [B], a pegged half lap joint detail [C]

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper presents interdisciplinary research that explores using an underutilized byproduct of the U.S. hardwood industry as a sustainable building material. The white oak "cant" is the center cut of a milled log and is typically sold "green" or undried due to characteristics that limit its usefulness as a traditional dry lumber product. Currently, cants are used in the manufacturing of shipping pallets, a low grade product with a short life. However, as cants are not kiln dried or further processed, they could be used as a low cost building material with extremely low embodied energy. Yet, there are obstacles that prevent their introduction into the construction market, such as a lack of contemporary architectural and/or engineering knowledge in the U.S. about green oak in building design. In addition, there is no regulatory pathway in building codes for green oak structural members with cross sectional areas as small as pallet cants. Therefore, this work consists of testing cants' structural capacity, dimensional movement in assembled mockups, and weathering characteristics in exterior applications. The conclusions of these tests are contributing to the development of a full scale demonstration project, which will be monitored for structural and thermal performance over a period of two years.

KEYWORDS: *TIMBER CONSTRUCTION, STRUCTURE, EMBODIED ENERGY, AFFORDABLE, HARDWOOD, OAK*

INTERGRATION OF PASSIVE DESIGN STRATEGIES INTO A SECONDARY SCHOOL PROJECT IN THE COLD CLIMATE REGION OF CHINA

Qiong Huang, Yaning Mao, Anxiao Zhang, Qi Zhang

School of Architecture, Tianjin University

Perspective view of the south elevation of the secondary school project

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Passive design focuses on the relationship between building and bioclimatic factors in our natural system. It aims to provide occupants with comfortable building environments and impact on energy conservation and ecological health in a positive manner. Passive design challenges vary depending on climatic and site related contexts, the building occupancy mode, and even clients' priorities. During a secondary school project in Tianjin, China, our team worked in a semi-digital design mode based on sustainable ideologies, and explored effective passive design strategies to fit local climatic forces and environmental factors. The design/research objective is to get optimum solution of a high performance school building, providing comfortable indoor and outdoor environment for formal or informal learning, and reinforcing the students' connection between indoor and outdoor spaces.

Tianjin is a typical city in the cold climate region of China. Considering that the school summer holiday lasts from mid-July till the end of August, the building is not equipped with a mechanical cooling system. In winter, the heating system runs from mid-November to mid-March. Hence natural ventilation (including fan-assisted and mechanically assisted natural ventilation) for passive cooling and the maintenance of indoor air quality, passive heating, daylighting and solar shading were synthetically considered in this project.

During the design process, we applied adaptable passive strategies in site planning, building form and geometry generation. During the stage of site planning, simulations of airflow and sun path & shadows were conducted to evaluate outdoor thermal comfort and provide evidence for site design optimization. During the early stage of building design, three plan configuration typologies were created and comparatively analyzed in order to achieve the optimum design option.

KEYWORDS: *PASSIVE DESIGN, SCHOOL BUILDING, BUILDING PERFORMANCE SIMULATION, COLD CLIMATE REGION*

EVALUATING VENTILATION PERFORMANCE OF WORK-SPACES IN READY-MADE GARMENT FACTORIES: THREE CASE STUDIES IN BANGLEDASH

Md Mohataz Hossain, Benson Lau, Robin Wilson
The University of Nottingham

Brian Ford
Natural Cooling Ltd

Figure showing surface temperature profile of a work-space environment in a garment factory building

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

As a continuation of the author's previous research work and a pilot study of a doctoral research, this paper adds new evidences and observations from an extensive field study in three multi-storied Ready-made Garment (RMG) factory buildings in Bangladesh. It focuses on the thermal environment of production spaces in relation to existing ventilation conditions and workers' adaptive strategies, particularly in cool dry season (December – February) in the tropical climatic context. The main aim of the paper is to evidently investigate the ventilation performance of the production spaces in terms of indoor Dry-Bulb Temperature (DBT), Relative Humidity (RH), Radiant or Globe Temperature (GT), Air Velocity (AV), Ventilation rate or Air Volume Flow Rate (AVFR), Carbon dioxide (CO2) and Carbon monoxide (CO) levels. The additional aim is to propose ventilation guidelines with passive solutions in different existing production spaces through lessons learning from existing adaptive strategies.

This paper reveals the existing ventilation conditions and thermal performance of the different production floors (cutting, sewing and ironing sections) in all segmented hours of a day within a minimum ten representative days (including a weekend) in three buildings in the chosen season. Moreover, the statistical and comparative analyses propose the adaptive measures which will be useful to improve the existing ventilation conditions through applying passive design approach in cool-dry season. The main aim of this continuous research work is to improve the existing ventilation condition for the garment worker's health, safety and comfort. Previous research shows that improving workspace environment increases users' physical well-being and performance.

KEYWORDS: *Ventilation performance, production spaces, thermal comfort, passive design approach*

RURAL (LOW INCOME) HOUSING: INSPIRING COMMUNITIES TO SHAPE THEIR FUTURE

Achilles Ahimbisibwe, Alex Ndibwami, Thomas Niwamara

Uganda Martyrs University

Example of rural low-income housing near Uganda Martyrs University.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Sustainable rural development is vital to the economic, social and environmental viability of nations. In many countries today, built environment strategies to address sustainable development tend to focus on large-scale programmes in fields such as renewable energy and energy efficiency. While this approach can improve national environmental indicators such as carbon emissions profiles, it appears unlikely to achieve sustainability (Gampfer, 2012). Further, most of these programmes in Africa focus the teaching and learning aspects of sustainable development in the more urban settings; relegating rural areas to mere destinations for project implementation. The narrow focus on urban centres is counterproductive because in the long run, negative impacts of deficient rural practices eventually affect urban centres. This paper argues that rural universities can provide a more comprehensive approach to long-term social, environmental and economic development in rural communities. Neighbourhood-scale development interventions, which enhance day-to-day living patterns, are more sustainable in the long run. Further, teaching methods suited for interdisciplinary or intercultural cooperation are a key element of built environment characteristics, which support sustainable development. In this paper these are referred to as 'Neighbourhood-scale' approaches, which are envisaged to ensure transfer of technology, improvement of construction skills, innovative use of available materials and a comprehensive concern for the environment.

KEYWORDS: *Low-Income, Housing, Neighbourhood-scale, Well-being, Sustainable development*

NEXUSHAUS – A CONTRIBUTION TO THE SOLAR DECATHLON 2015 IN IRVINE/CALIFORNIA

Werner Lang, Simone Salfner
Technische Universität München

Michael Garrison, Petra Liedl, Adam Pyrek
University of Texas at Austin

NexusHaus South-East elevation

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In order to guarantee the sustainable use of the resources available for supporting the fast growing population of our planet, stabilizing our world's climate and securing our quality of life, the building sector has to fundamentally rethink the concept for dealing with energy, materials, water, and other resources. To demonstrate how the described challenges can be met in a holistic, life-cycle based and productive way, the University of Texas at Austin (UT) and the Technische Universität München (TUM) decided to develop, design and build the so-called NexusHaus as part of the international competition "Solar Decathlon 2015" organized by the U.S. Department of Energy. Its innovative design addresses the energy-water-nexus for cities in hot climates, such as Austin, Texas. A central aspect of the design of the NexusHaus is the linking of social, environmental, economic and cultural aspects. The NexusHaus offers a flexible option for sustainable, affordable housing throughout Austin's underutilized alleyways. Integrated photovoltaic modules serve as the main source of energy. Recycled rainwater will be used to irrigate the landscape. An aquaponic system and integrated gardens are capable of producing food for the inhabitants. The permaculture aspect of the design focuses on working with nature to promote the natural ecosystem. The building is currently under construction and will be presented to the public in early October in Irvine, California.

KEYWORDS: *Sunstanability, Cradle to Cradle, Nexus, Energy-Plus-Buildings, Solar Architecture, Passive Design*

HOUSING PERFORMANCE ANALYSIS: INDOOR VEGETATION AS A DESIGN STRATEGY

Adolfo Gómez-Amador, Carlos J. Esparza-López, Marcos, González-Trevizo, Carlos Escobar del Pozo, Alberto Méndez-Gómez - Universidad de Colima
Pablo Elías López - Universidad A. Metropolitana

Studied space seen from the ground.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper focuses on evaluating the vegetation performance on inner and adjacent spaces and its effects as a natural air-conditioning design strategy in a sub-humid warm climate. Study was carried out using comparative analysis on a typical housing prototype in Colima city (103°48′ W, 19°12′ N).

The experimental method proposed consisted on modifying vegetation through selective pruning in order to change the volume of vegetation within an indoor garden; with this, dry-bulb temperature and relative humidity values were recorded and compared in the analysed housing spaces –the entranceway and the indoor garden itself– and the outside as reference measure to study comfort parameters as a result of the use of two different pruning configurations.

A correlational method was implemented to study the data collected in analysed spaces with different configurations of vegetation, this was useful to determine the impact of selective pruning through experimentation. The indoor garden showed a maximum difference of 3.7°C between variations of vegetation volume, while at the entranceway the thermal impact observed was 2.8°C.

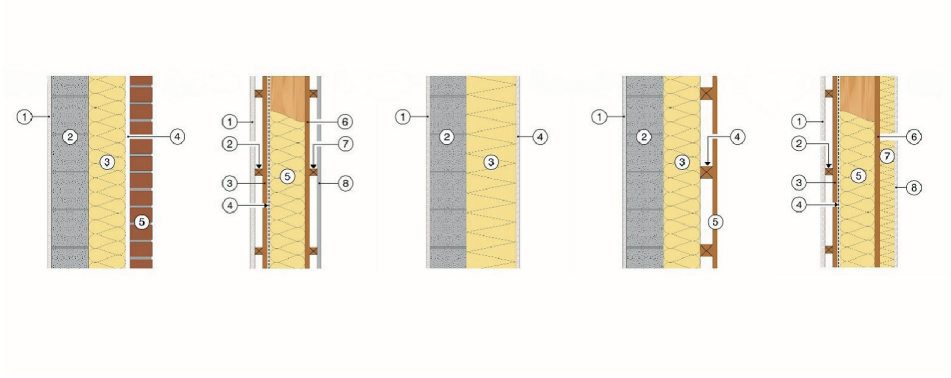
Results not only showed the significant role of vegetation on natural air-conditioning in a sub-humid warm climate, but also the possibility of future performance in cross-sectional studies, where results of modifications in a case of study can be compared to an space studied longitudinally.

KEYWORDS: *Indoor vegetation, Housing, Hot sub humid climate.*

OPTIMIZATION OF FACADE WALL BUILDING SYSTEMS IN WALLOON REGION

Clotilde Pierson, Arnaud Evrard

Architecture et Climat



Detail drawings of analysed facade wall building systems

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

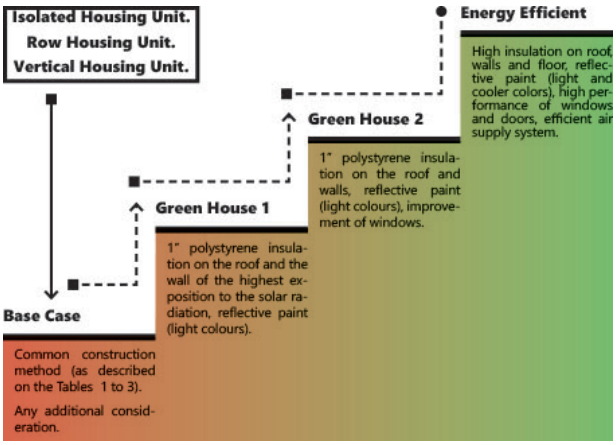
As our society experiences a significant demographic expansion, 350 000 new households in Wallonia will need to be erected by 2040. However, the Belgian index of construction costs is constantly increasing due to building lots scarcity and high requirements in terms of energy efficiency. A funding problem appears as the Walloon average income has not improved, hence the need to control building costs in order to offer quality accommodation for everyone. This two year research aims to create a support tool reducing costs of new buildings without jeopardizing comfort, structure or durability. Three action plans are set in order to achieve this goal: the optimization of wall building systems, the development of more efficient habitation practices and the restructuration of the organizational model of building companies. The present paper states the first action plan of the study, namely the optimization of the wall building systems. The final objective of this first step is to highlight the factors impacting significantly on wall prices and to offer more economical or ecological solutions. During this first step, the authors defined the most used building systems for each type of wall. They determined some relevant variants of the reference building system and established their price and environmental performances. At the present time, the research compared only facade wall building systems. As of yet, the results are not extensive enough to draw definitive conclusions. However, preferential choices are presented providing relatively good environmental and economical performances. More general findings have also been highlighted but still require verification; for instance, the larger the amount of different layers that are assembled in a building system, the higher its price will be. Additional analyses are needed to extract aspects that will have a decisive role in the optimization task.

KEYWORDS: *OPTIMIZATION, COMPARATIVE ANALYSIS, BUILDING SYSTEMS, ENVIRONMENTAL AND ECONOMIC CHARACTERISTICS*

A BETTER SOCIAL HOUSING FOR MEXICO CITY: EVALUATION OF DESIGN AND INDOOR ENVIRONMENT OF COMMON TYPOLOGIES

Alejandro Moreno Rangel, Filbert Musau

The Glasgow School of Art



Summary of improvements. Source: Author.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper compares thermal comfort in the most common social housing typologies in Mexico City. It is based on a Base Case plus three different improvement's group. They are determined by the most common construction methods in Mexico, the Green Mortgage Program (Mexican programme for sustainable social housing), personal recommendations and the Passive House standards proposed for temperate climates. The approach into the building envelops aims to provide a better IEQ and highlight the actual weaknesses. Therefore, this paper only dwells on Thermal comfort: Temperature and Moisture.

The typologies taken for this study are Row Housing, Isolated Housing and Vertical Housing; which vary from 42 to 52 square meters per dwelling with different designs, but the same architectural programmes. Results are compared and discussed with the use of graphics and tables on the hottest and coldest day in Mexico City. Discussions of the results are presented in just one of the typologies. However, the analysis of the three typologies on the four Study Cases was made and their results presented in a table.

On the analysis of the results can be observed that two Study Cases provide a better IEQ on the three typologies. This suggests that they are the best approaches. Thermal mass and insulation working together prove that it is possible to maintain the thermal comfort range without mechanical supply of heat and/or cooling. The estimated higher cost on the Passive House improvements makes it not accessible for social housing on the Mexican context.

KEYWORDS: *Sustainable homes, Sustainable social housing, Cool temperate climate.*

UNIVERSAL DESIGN AT WORLD'S LARGEST RELIGIOUS CONGREGATION – KUMBH MELA PILGRIMAGE AT UJJAIN, INDIA

Ravinder Yadav, Venkatesh Kanisetti

School of Planning and Architecture, Bhopal, India

Pilgrim crowds gather for the holy dip during Kumbh Mela, Ujjain-2004

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper evidently introduces unique and sensible challenges being faced by the diverse users in a religious assemblage during a mass pilgrimage in India. Kumbh Mela, the Hindu festival where large pilgrim crowds gather to perform the holy rituals, has been coined as the world's largest religious festival and also largest human gathering on the earth. Universal design became a worldwide revolution and each country looking to fraternise their disabled and aged population in all operating scales of product design, architecture and urban planning. The challenge here is India being the country with huge population that too with more diversity in needs, culture and ability. Diversity challenge blending with the strong cultural and religious context is the main challenge that is being tried portraying in the study by the authors. The objective of the research work is to arrive at architectural and planning (R)solutions for this sensible social and environmental challenge. Also this paper contributes an apt approach methodology which can be adopted for a study with similar aims.

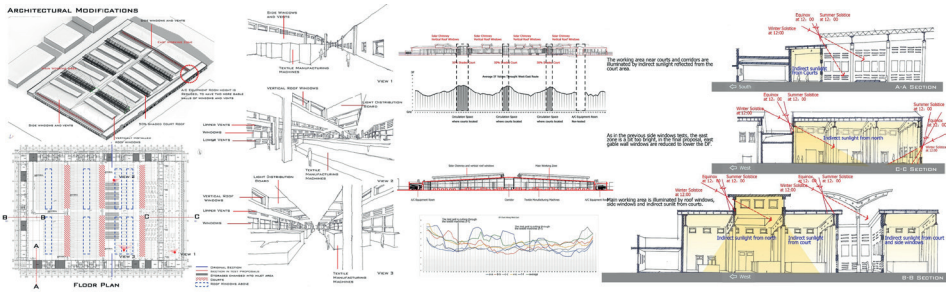
KEYWORDS: *Kumbh Mela, Religious congregation, Universal Design, User Centric Approach.*

INNOVATIVE PASSIVE LOW DESIGN STRATEGIES FOR GARMENT FACTORIES IN NORTH CHINA

Jing Li - SD Weijian Engineering & Design Ltd

Benson Lau - The University of Nottingham

Brian Ford - Natural Cooling Ltd



Architectural Modification and Tests of the optimum proposal (Source: Drawn by author)

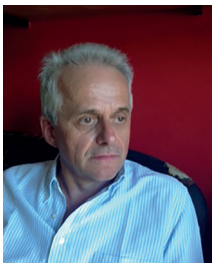
WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Since industry revolution, factory buildings have been recognised worldwide by its infamous working conditions and the relatively poor energy performance of this type of building is mostly ignored, so the challenge is not only improving the energy performance of this type of building but also creating 3desirable and pleasant working environments for the workers. This study starts with a critical review of the existing garment factory buildings in mainland China, with a special focus on the working conditions and the associated environmental performance and energy consumption of the garment factories. In addition, detailed field studies have been conducted on this existing textile factory building from its current climate conditions, building design details, environmental design performance and current energy performance. Then four preliminary proposals of architectural changes are proposed by adopting different passive design strategies.

After undertaking performative testing on each of the proposed design options, an optimum building form is developed and further testing has been carried out to identify the most appropriate passive design strategies for the textile buildings in China. (The parametric studies were carried out on the luminous environment, ventilation system, thermal performance and human comfort by selectively using building performance prediction software like Tas, Optivent, Ecotect, Radiance, flow design and Fluent)This study concluded that with a thorough understanding of the local site micro-climate conditions, the identification of the free-running period in a year and the adoption of the evidence based integrated environmental design approach and the feasible passive design strategies, less energy intensive garment factory buildings with improved working environments and building performance can be constructed.

KEYWORDS: *Evidence based design, garment Factory, working conditions, building performance*



Sim[PLY]

Albright , Vincent Blouin, Dan Harding, Ulrike Heine, Dave Pastre, Luca Rocco, Stephens

Clemson University

The innovative Sim[PLY] framing system offers a high-performing alternative to traditional light wood framing.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

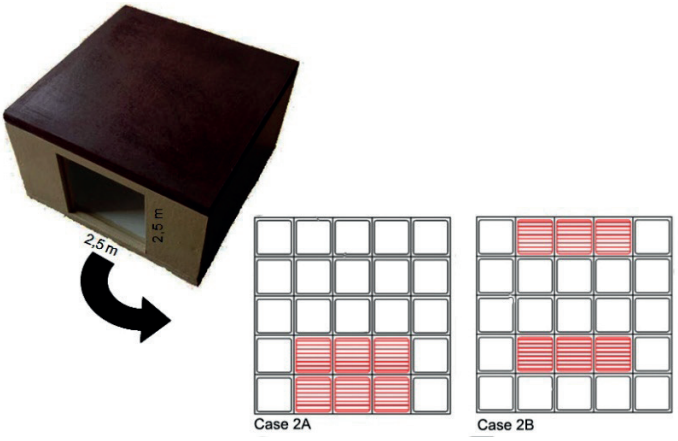
Research Summary

Sim[PLY] revolutionizes construction providing lightweight, prefabricated structural components for easy assembly. Through the design, Sim[PLY] inherently addresses the economics of building, the environmental benefits of locally sourced materials and zero waste construction, and the social impacts of low-energy housing and "DIY" communities. Structural plywood components for Sim[PLY] are cut offsite by CNC milling machines. This allows integration of intelligent features into the framing components themselves, promoting higher efficiency in material usage and onsite construction operations. The interlocking components are numbered, flat-packed, and shipped directly site for assembly as a three dimensional structural puzzle. Sim[PLY] pushes sustainability efforts by using locally sourced plywood, both renewable and highly sustainable. All wood building materials, including engineered products like plywood, feature low embodied energy levels compared to alternatives, even after factoring in CNC operations. Additionally, the structural mechanics of plywood and our specially-designed connections make Sim[PLY] especially resilient, even in high wind and high seismic zones. Ongoing research is testing a model using 12-inch (30.48 cm) Sim[PLY] wall cavities. These cavities provide ample space for fully-integrated systems, which pass through labeled cutouts designed into the Sim[PLY] pieces. These measures facilitate efficient construction while preserving interior living space, allowing homes with small footprints to "live big." Homes made with the Sim[PLY] system will offer higher levels of usable square footage without sacrificing affordability. Aside from environmental impacts, the Sim[PLY] system challenges construction safety by enabling cleaner and safer construction sites. In a recent application, a Crop Stop Market was constructed without onsite waste.

KEYWORDS: *WOOD, STRUCTURE, ECONOMICS, SAFETY, IMPACT, INNOVATION*

NATURAL VENTILATION: THE INFLUENCE OF OPENINGS POSITIONING FOR A MODULAR FAÇADE

Helenice Maria Sacht - UNILA
Luis Bragança, Manuela Almeida - University of Minho
Edson Matsumoto - University of Campinas
Rosana Caram - University of São Paulo



Configuration of facades to wind tunnel tests

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Natural ventilation has served as an effective passive cooling design strategy to reduce energy used by air-conditioning systems. The correct utilization of natural ventilation beyond reduces the energy consumption and improves the thermal comfort of users. For better natural ventilation performance is important that shape and position of inlets and outlets ventilation openings be properly designed. For this purpose, wind tunnel tests are a reliable tool to determine the influence of natural ventilation in buildings, which is the specific objective of this research. Based on the importance of natural ventilation study for buildings, this paper presents results of wind tunnel measurement to evaluate the influence of different ventilation modules positioning on a façade system. The positioning of ventilation modules was modified in the façade configuration for evaluate the results in the average air velocity at specific points observed in a model. The tests were carried out for a model, varying the façade configuration. The cases tested were six ventilation modules positioned below the window-sill (ventilated window-sill), three ventilation modules positioned separately above and below the façade for modules. Wind speed measurements were taken inside and outside the model for the different façades configurations to evaluate the best performance in relation to natural ventilation. Results show the use of six ventilation modules positioned below the window-sill, forming a "ventilated window-sill" is the best solution in terms of natural ventilation.

KEYWORDS: *Façade, Natural ventilation, Wind tunnel tests, Ventilation modules.*

ENERGY CONSUMPTION VS. USERS' PERCEPTIONS: A QUANTITATIVE STUDY OF ENERGY AND COMFORT IN UNIVERSITY CAMPUS

S.N.N.-Syed Yahya, Ati Rosemary-Mohd Ariffin
Muhammad Azzam-Ismail

University of Malaya

How much energy for a thumbs up? (image source: Pye, K. (2013))

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The relationship between users' perceptions of comfort and energy performance is an important integration of society with the environment which also have indirect implications to the economy. Achieving users' comfort in buildings involves the use of energy where multiple studies have associated energy use via heating and cooling as predictors of users' comfort. However, these studies have neglected the magnitude of energy needed to achieve comfort. Therefore, the current paper investigates the quantum of electricity used in a public university to achieve users' comfort. The investigation adopts the quantitative method of comparing electricity consumption and users' comfort via two different instruments namely; energy loggers and occupant survey. An energy logger was installed on three study buildings while an occupant survey was distributed to users of the same buildings. Benchmarking was used to compare energy indices of the study buildings. It was found that the study building with the highest energy index also scored the highest perception of comfort by the users. As thermal control for indoor comfort account for more than half of the total electricity consumption, the result suggested that electricity consumption predicts users' comfort positively. However, the ratio of energy consumed and comfort achieved is questionable. This study suggests that a substantial amount of electricity is needed to achieve a small measure of comfort. Additionally, the study also revealed that two of the study buildings performed poorly in terms of energy performance while one performed fairly well with the potential of becoming an energy-efficient building. By replicating the study to other buildings, the research can help identify energy-efficient potentials in buildings towards reducing the campus' energy consumption holistically.

KEYWORDS: *USERS' PERCEPTION, USER COMFORT, OCCUPANT SURVEY, ENERGY PERFORMANCE, ACADEMIC BUILDINGS, BUILDING PERFORMANCE*

UK PRIMARY SCHOOL EXTENSION: BUILDING PERFORMANCE EVALUATION

Meital Ben Dayan

Architype

Bessemer Grange Primary school extension, London

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The physical learning environment has an important role in the health and well-being of its occupants as well as affecting learning outcomes. Forming 15% of the UK public sector carbon footprint and with typical building life of more than 60 years, school buildings play a significant part in UK carbon reduction targets. However despite investment targeting reduced carbon footprint, available figures for new school buildings show high energy consumption in relation to existing stock and 2-3 times higher than prediction at design stage. Post occupancy evaluations also indicate usability and operation difficulties which significantly affect comfort as well as energy consumption. This paper aims to contribute to the understanding of school buildings performance and draw conclusions for future buildings through a detailed study of a naturally ventilated London Primary School new built extension. It summarizes a three-year Building Performance Evaluation conducted as part of UK Technology Strategy Board's building studies. The study showed very high user satisfaction and good comfort level. Improved learning outcomes and community perception were evident after the completion of the new building. Heating demand and embodied carbon were found to be low in comparison to existing benchmarks. The overall energy consumption however, was found to be higher than predicted and the electricity consumption was high in comparison to average existing schools. In addition usability and control difficulties contributed to reduced performance, compromised natural ventilation and caused overheating in parts of the building. Analysis of the successful elements and challenges identifies key contributing factors and makes recommendations in relation to future schools design.

KEYWORDS: *School Buildings, Case Study, Building Performance Evaluation*

THERMAL PERFORMANCE OF VEGETATED ROOFS FOR A COMMERCIAL BUILDING IN A SEMIARID CLIMATE

Waldo Bustamante - School of Architecture - Pontificia Universidad Católica de Chile (PUC, Chile)

Camilo Pinto, Sergio Vera, Felipe Victorero, Jorge Gironás, Carlos Bonilla - School of Engineering, PUC, Chile
María Victoria Rojas - VR + ARQ Chile

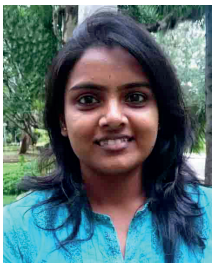
Laboratory of vegetated roofs and walls. Santiago, Chile.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Vegetated roofs (VRs) have been widely studied, with more emphasis on regions with high rainfall climates. Fewer studies about VRs have been done for hot-dry climates. The increase of VRs is evident in rainy regions, with effects such as water runoff control along with improvement on thermal and acoustic performance. In hot and dry climates, there have been problems in plants' behaviour due to high temperature and solar radiation as well as shortage of rain, especially during summer periods. In order to explore the main parameters of VRs that influence the thermal performance of a 1 storey supermarket building in Santiago of Chile -a city with a semiarid climate- different thermal simulations have been carried out. DesingBuilder software and a VRs model (Saylor, 2008) has been used. Simulations for estimating annual heating and cooling demand were made. Monthly and daily heat fluxes through roofs were also studied. Variations of substrate's density, plant characteristics and water content of growing media were considered. In order to compare VRs thermal performance, a non-insulated and a thermal insulated slabs were also simulated. Results show that the leaf area index (LAI) highly influences the cooling effect of VRs for both heavy wet or light dry substrates.

KEYWORDS: *Vegetated roofs; substrate; leaf area index; semiarid climate; heating and cooling demand*



INFLUENCE OF NEIGHBOURHOOD ATTRIBUTES ON THE PERCEPTION OF QUALITY OF LIFE OF THE ELDERLY IN INDIA

Ms. Suparna Saha, Dr.Sanghamitra Basu, Dr. Debapratim Pandit

IIT Kharagpur, India

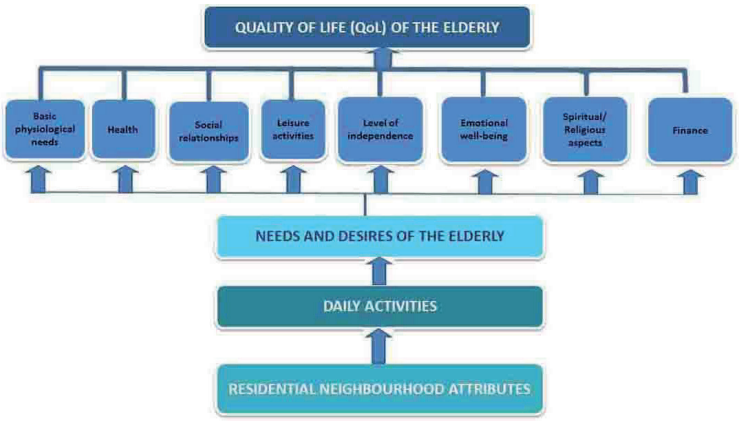


Diagram representing the relationship between neighbourhood attributes and QoL of the elderly

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

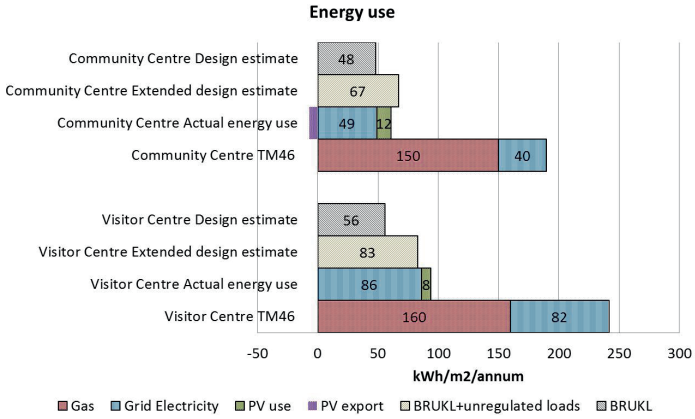
India is experiencing an unprecedented rise in its number of elderly citizens. Studies on senior citizens in India report their deteriorating physical and mental health conditions, social relationships, psychological well-being and increase in vulnerability to abuse, which lead to the decline in their overall quality of life (QoL). In India, the physical limitations of the elderly coupled with their preference to age-in-place restrict them to the boundaries of their residential neighbourhoods. Thus the neighbourhood becomes essential for improving the QoL of the elderly. The neighbourhood is important in determining the daily activities of the elderly, which in turn leads to the fulfilment of their needs and desires and finally impacts upon the perception of their QoL. A thorough understanding of the essential neighbourhood attributes for the elderly, seeks an in-depth understanding of the needs of its elderly residents. In an attempt to understand the influence of neighbourhood characteristics on the perception of QoL of its elderly residents, this study analyses two variety of residential neighbourhood development pattern - organically developed and planned- existing in Kolkata, India. Through focus group surveys, the study investigates the extent to which the perception of QoL, determined by the diversity in the needs of elderly residents, of varied socio-economic background, is catered to by the attributes of their neighbourhood. The findings shall help in identifying a list of neighbourhood attributes which the elderly perceive as essential to cater to their needs and influence their QoL.

KEYWORDS: *QUALITY OF LIFE, ELDERLY, SENIOR CITIZENS, RESIDENTIAL NEIGHBOURHOODS*

LEADING-BY-EXAMPLE: COMPARATIVE EVALUATION OF THE ACTUAL PERFORMANCE OF TWO LOW-CARBON COMMUNITY BUILDINGS IN UK

Rajat Gupta, Mariam Kapsali

Oxford Brookes University



Annual energy use and comparison with design estimate and CIBSE TM46 benchmark.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

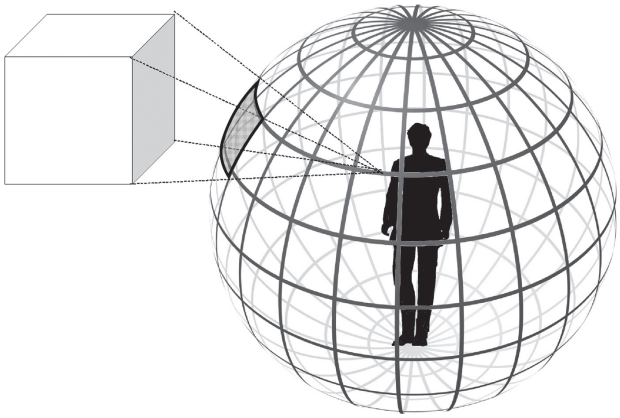
This paper uses a forensic building performance evaluation (BPE) approach to undertake a comparative evaluation of the in-use energy and environmental performance data of two naturally-ventilated community buildings, Community Centre and Visitor Centre, located in Southeast England. Both buildings are designed to high sustainability standards (measured air-permeability rates of ~5m3/hr.m2) and low heating demand met by on-site low/zero carbon technologies (LZTs). Overall the energy performance of the two case study buildings is better than benchmarks indicating the success of fabric first approach and contribution by heat pumps and solar Photovoltaic systems. Nevertheless both buildings encountered similar issues related to poor handover and guidance that undermined the ability of occupants to control their environment; lack of as-built documentation; problematic commissioning and lack of calibration of energy sub-meters. Despite these issues, both buildings are performing well. However the energy use of the Community Centre is lower than that of the Visitor Centre, due to the simplicity of the building system and controls, combined with good performance of the LZTs, and complemented by the careful management of the building by an Energy Champion. Findings from the study show that with appropriate fine-tuning through BPE studies, community buildings can become the sustainable exemplar they were designed to be. Wider lessons from the study can also inform future community building design, specification and performance.

KEYWORDS: *Building Performance Evaluation, Low carbon building, Performance Gap*

INVESTIGATING EFFECTS OF LONGWAVE RADIATION USING SPHERICAL PANORAMIC THERMOGRAPHY

Mate Thitisawat, Jean-Martin Caldieron
Florida Atlantic University

Kasama Polakit
University of Idaho



Relationship between man and environment through longwave radiative heat exchange

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Thermal comfort represents a human centric requirement for built environment. It is governed not only by climatic conditions, but also by environmental topology, geometry and thermo-optical properties of material. Evidently, there is a need for assessment of outdoor thermal comfort condition since it enables environmental designers to evaluate outdoor built environment and allow them to suggest climate and context responsive design criteria or policy. The study started as a pilot study funded by Architectural Research Centers Consortium (ARCC) and Florida Atlantic University. It investigated South Florida urban public spaces, and involved data collection of an entire year through questionnaires and measurements. The goal of the study was to investigate assessment method for the outdoor comfort that may lead to more walkability, and hopefully more economic stimulation. Different models were scrutinized and calibrated. Dynamics of the outdoor conditions presents a challenge in the process. The complication includes effects from wind and its interaction with complex environment, and both shortwave and longwave radiation. This study offers a different approach in measurement that may not be practical with available technology due to unresponsiveness and a requirement for tedious manual data processing. The proposed method through visualization using infrared camera can become practical when some promising digital photography technologies and software developments in different applications such as real-time photo stitching, fish-eye lens and sweeping panorama migrate to environmental sensing.

KEYWORDS: *Outdoor thermal comfort, thermography, longwave radiation measurement*

BLAST ENHANCED FACADES- A BALANCED DESIGN APPROACH FOR SOCIAL SUSTAINABILITY

Marc Zobec (PhD),
Raymond Lumantarna (PhD),
Guido Lori (PhD)

PERMASTEELISA

Blast enhanced versus conventional façade - post arena test

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The term sustainable architectural design has become synonymous with the effects of global warming and efforts to reduce energy consumption and carbon emissions. It is a real though unfortunate fact that terrorist attacks are a present day threat. Terrorist attacks due to blast are carried out behind the camouflage of everyday life and are aimed at the general population with the primary goal being to create fear, shock and outrage in society (Mays, 1995). In the event of a blast, the primary cause of injury is due to glass fragmentation. Yet with regards to energy efficient buildings, there is an architectural trend to maximise natural daylight and transparency through the use of full height glazing in facades. This creates a design paradox. "Hardening" buildings by minimizing glass surface areas and reinforcing the structure not only places restrictions on architectural freedom, but also on occupant interaction with the built environment; a victory in itself for terrorists. Physical protection must also be considered a sustainable constraint in every building design. Facades are comprised of a combination of components. By understanding how these components interact as well as component material behaviour under high strain rates, a fully glazed façade can often be economically achieved providing transparency, protection against the blast shock wave itself as well as glass fragmentation hazard reduction. This paper outlines R&D programs carried out to understand the behaviour of facades subjected to blast, as well as material behaviour under high strain rates. Analytical models were developed to predict performance and calibrated through full scale arena testing.

KEYWORDS: *Blast Enhanced Facades, Balanced Design, SDOF, MDOF, Dissipative design*

15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Post Carbon Cities

1st Parallel Session

DAY 1

14:00 – 16:00

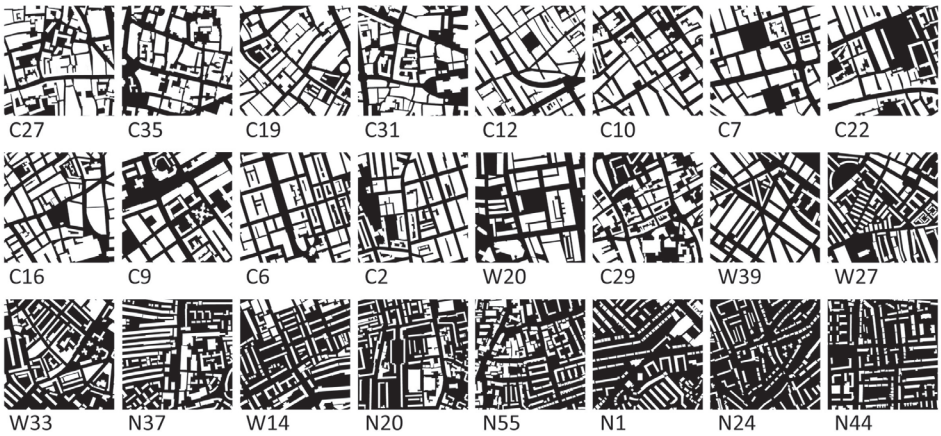
CHAIRMEN

Heide Schuster ..... Table 4
Edward NG ..... Table 5
Maria Federica Ottone ..... Table 6

COMPARING THE SOLAR PERFORMANCE OF URBAN FORMS IN LONDON

Christina Chatzipoulka, Marialena Nikolopoulou
Kent School of Architecture, University of Kent

Raphaël Compagnon
Haute école d'ingéniérie et d'architecture de Fribourg



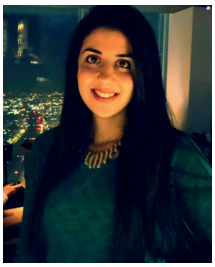
Twenty-four squares from central (C), west (W) and north (N) London, in decreasing order of density

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The paper explores the impact of urban geometry on solar availability in twenty-four urban forms of London. The morphological analysis of the urban forms was based on their digital elevation models (DEMs), for which density and six urban form descriptors were computed using image processing techniques. Solar radiation and mean radiant temperature (Tmrt) simulations were performed using PPF and SOLWEIG softwares, respectively. The statistical elaboration of the results reveals a strong correlation (r>-0.950) between density and mean ground and façades sky view factor (SVF) values. Furthermore, among the urban form descriptors considered, mean outdoor distance, site coverage and frontal area density were the most influential for the solar performance of open spaces; whilst solar availability on building façades was mostly affected by frontal area density and standard deviation of building height. The influence of the orientation of urban forms was found to vary with the sun's altitude: the lower the altitude, the greater the influence. The seasonal performance of the urban forms in enhancing outdoor thermal comfort was evaluated through solar availability and Tmrt in open spaces. According to the climatic data of London, for 87.5% of daytime hours solar radiation would enhance outdoor thermal comfort. In this context, urban forms of lower density perform in general better allowing more solar radiation on the ground. However, as increased density is an objective for urban environmental sustainability, design solutions for enhancing solar availability in high/medium densities were explored. According to the findings, some general guidelines can be identified: i) lower coverage (and thus taller buildings) is preferable, ii) building forms should be designed with minimum undulations and iii) vertical and horizontal randomness is beneficial.

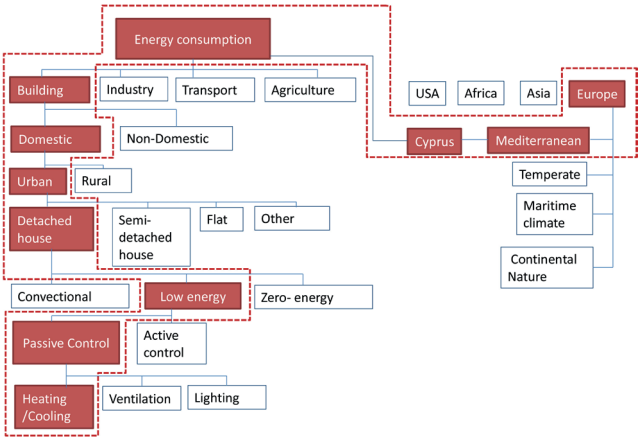
KEYWORDS: *URBAN GEOMETRY, URBAN FORM, DENSITY, SOLAR AVAILABILITY, OUTDOOR THERMAL COMFORT, SVF*



TECHNICAL VIABILITY OF LOW-ENERGY STRATEGIES TO MEET PASSIVHAUS STANDARDS FOR DOMESTIC BUILDINGS IN CYPRUS

Chryso Heracleous, Stephen Lo

University of Bath, UK



Boundaries of the research.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study examines the technical viability of low-energy strategies applied to domestic buildings in Cyprus to meet Passivhaus low-energy building targets of 15kWh/m2/yr for cooling and heating demand. European Legislation requires all new buildings to be nearly zero-energy by 2020, driving Cypriot government bodies to evaluate strategies to meet this target. A reference building, representing existing best practice Cypriot residential construction, was modelled using dynamic simulation software to analyse its energy consumption. Simulations showed that the total energy consumption of the reference building was 117.8 kWh/m2/yr for heating and cooling with infiltration and conductive heat losses in winter and solar gains in summer having the greatest impact. Two groups of passive strategies, (individual and then combined strategies), were proposed in order to quantify their effectiveness in meeting Passivhaus targets of 15kWh/m2/yr. The most effective combination of infiltration rates of 1ac/h (air-changes per hour) at 50Pa, a window-to-wall ratio of 20%, an effective area for ventilation with proper window operation, night cooling, movable exterior shading, double low-e glazing with insulated aluminium frames, 100mm of wall insulation and 100mm of roof insulation, reduced the energy demand for heating and cooling to near-Passivhaus Standards of 15.7 kWh/m2/yr (an 87% reduction).

KEYWORDS: *Residential buildings, Passive strategies, Passivhaus Standards, Cyprus, Energy consumption, Thermal comfort, Indoor Air Quality.*

ASSESSMENT OF ENERGY EFFICIENCY OF THE ENVELOPE OF LOW-INCOME HOUSES IN BRAZIL

Laiane Susan Silva Almeida, Enedir Ghisi

Federal University of Santa Catarina, Department of Civil Engineering, Florianópolis, Brazil

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The objective of this study is to analyse the energy efficiency of the envelope of 50 low-income houses located in Florianópolis-SC, southern Brazil, by using the simulation method shown in the regulation for energy labelling. First, a questionnaire was developed to collect data related to the constructive characteristics of the houses. The data collected were the dimensions of rooms and of the whole house, sizes and type of openings, solar orientation, type and colour of walls and roof, etc. All houses were simulated using the EnergyPlus computer programme. Output data were hourly operative temperature and energy consumption for cooling and heating for each room. Thus, the energy efficiency level for each house envelope was estimated. Most of the house envelopes were ranked as level "E" (58% of the sample) and the best level obtained was "C" (14% of the sample). The possible main cause for such poor envelope efficiencies is the constructive practice, which does not take into account the climate where the houses are built. In order to improve the energy efficiency level of the envelope of the houses, it would be necessary to improve the quality of walls and roofs as well as use larger openings to increase natural lighting and natural ventilation levels in the rooms. The main conclusion is that the house envelopes are not energy efficient and that the obligatory application of energy labelling and/or developing stricter regulatory standards for new buildings would be necessary. This would improve the constructive practice in terms of energy efficiency.

KEYWORDS: *Energy efficiency; Residential labelling; Low-income houses; Computer simulation.*

URBIUS: A METHOD FOR ASSESSING THE SUSTAINABILITY OF URBAN RENEWAL STRATEGIES AT NEIGHBORHOOD SCALE

Maria Gracia RIERA PEREZ - Laboratory of architecture and sustainable technologies (LAST)

Emmanuel REY - Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland

Existing urban fabric where URBIUS has been tested. Yverdon-les-Bains, Switzerland. © swisstopo

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

One of the main challenges of European post-industrial cities is to prevent urban sprawl. Hence, increasing the density of inner cities instead of building new constructions in the peripheries has become a priority. However, city centres are already built and occupied by communities. Therefore, urban renewal projects aiming at increasing the density of the urban fabric should take into account existing buildings, as well as people living and working on the site (Dupagne, Teller, & Ruelle, 2004). In this perspective, interdisciplinary approaches including sociocultural, economic and environmental parameters are necessary to lead urban renewal projects (EU, 2010). In addition, urban renewal projects cannot be completed within a single phase; a strategy needs to be established and implemented over a long period of time, depending on the number of owners and activities in the existing buildings. With this in mind, developing a series of urban renewal scenarios at neighbourhood scale seems to be the most appropriate solution. It provides both a holistic vision and a case-by-case vision (Roberts, Struthers, & Sacks, 1993). This paper presents the URBIUS method, developed to assess the sustainability of urban renewal strategies at neighbourhood scale. The conceptual framework of URBIUS gathers the main issues of urban sustainability, including social, economic and environmental aspects. URBIUS is mainly used to compare different strategies for a single neighbourhood. Thus, the assessment thresholds are adapted to the specific potentials, and challenges. The aim is to support city planners in their prospective and proactive work of anticipating the sustainable urban transformation. A case study assessing three different scenarios for the "Moulins neighbourhood" in Yverdon-les-Bains (Switzerland) is also presented to exemplify the method.

KEYWORDS: *Neighbourhood, sustainability assessment, urban renewal, strategy, scenarios*

SOCIAL INTEGRATION HOUSING PROJECTS IN CHILE: A SATISFACTORY RESPONSE TO GENERATE MIXED NEIGHBORHOODS? VILLA LAS ARAUCARIAS, LA SERENA - A CASE STUDY

Scarlet Romano, Beatriz Cristina Maturana Cossio

Universidad de Chile

Villa Las Araucarias existing conditions (photograph) Source: Fondecyt Project N° 11130636.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study addresses the definition of social integration, the regulations and design guidelines for socially integrated housing. It approaches the Social Integration Housing Projects (SIHP) in Chile using the method of structural and management critical issues. We understand as critical structural and management issues any conditions that complicate and prevent the efficient realization of any purpose. These housing complexes have as an objective to reactivate the economy, subserve the social and territorial integration, incorporate affordable and social housing units in well-located neighbourhoods, including services, facilities and quality of the design (MINVU, 2014).

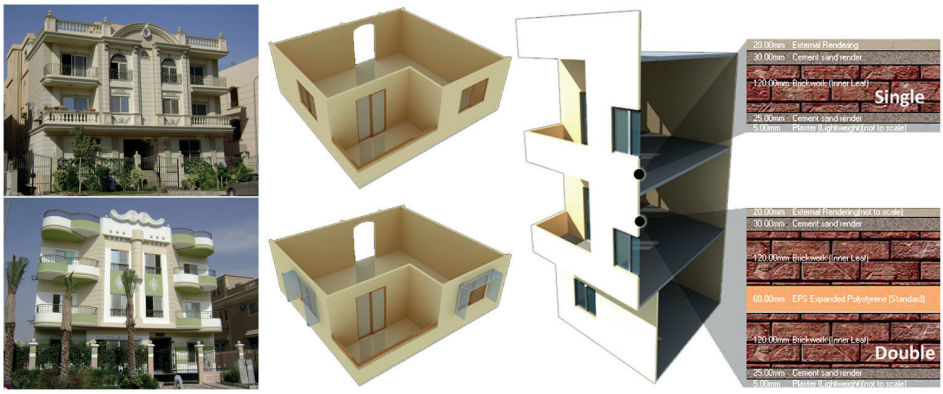
The central argument is that in spite of a clearer definition of the concept of social integration in urban policies, many obstacles to its implementation within the SIHP are still present in the physical realization of housing development projects. Critical structural and management issues complicate the implementation of the design guidelines for socio-spatial-integration. In an exploratory manner, this study develops diverse architectural and urban strategies in response to the critical issues presented. Among these strategies are the development of diverse typologies, density regulations, the creation of new regulations and proposals for different government approaches and the incentive of building mixed-income, inclusive and sustainable neighbourhoods. This urban-architectural design proposal is presented through an alternative physical-spatial scenario to the current configuration of the Villa Las Araucarias in La Serena. The result of this exploratory study suggests that these housing projects offer a limited tool to respond to the goal of social integration,.

KEYWORDS: *Social Integration Housing Projects, design and management guidelines, mixed-income neighbourhood, density*

COSTS AND BENEFITS OF USING PASSIVE COOLING TECHNIQUES IN EGYPTIAN DWELLINGS

Wael Sheta, Steve Sharples
School of Architecture, University of Liverpool, UK

Mohammed Mayhoub
CLTC, University of California, Davis, USA



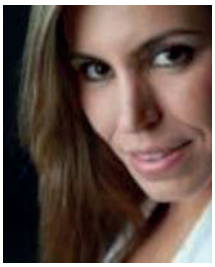
Egyptian dwellings and type of walls and solar shadings used in simulation

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study directs attention towards the New Cairo community, which is one of the new urban settlements that have been developed around Cairo, Egypt. People recently have tended to install or extend mechanical cooling equipment in their dwellings in order to overcome the problem of thermal discomfort from overheating. Although the mechanical cooling significantly raises utilities bills, it is still the preferred choice for the majority of the residents. The lack of awareness about the advantages of Passive Cooling Techniques (PCT), in addition to uncertain about their costs and effectiveness, has made PCT unpopular options for both designers and owners. This study investigates the costs and benefits of two PCT, which include the influence of the thermal transmittance of the walls (U-value), and the attachment of solar shading devices. The Whole Life Cycle Costing (WLCC) evaluation method is used to estimate the payback period of applying the PCT. The PCT were simulated using the dynamic thermal simulation software DesignBuilder to investigate their thermal performance and estimate the cooling load energy savings. The purpose of this paper is to compare the mechanical cooling against the passive cooling alternatives from a financial viability standpoint to enable appropriate solutions to be chosen at the early stages of a design. The study revealed that using thermal insulation can be considered a favourable scenario to achieve the most benefits in terms of the initial costs, the electricity cost savings, the payback period and the life cycle costs.

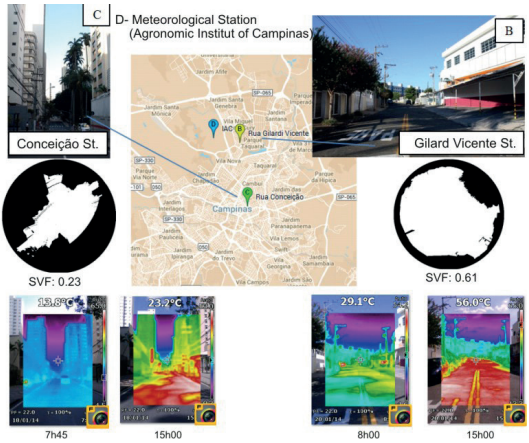
KEYWORDS: *Cost and benefits analysis, whole life cycle costing, passive cooling technique, dwellings, hot climate.*



INFRARED IMAGING ANALYSIS FOR ASSESSMENT OF THERMAL COMFORT IN OPEN AREAS OF TROPICAL CITIES: POSSIBILITIES AND LIMITATIONS

Loyde Abreu-Harbich, Victor Hugo Perina Sampaio, Lucila Chebel Labaki

University of Campinas



Field Studies

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study aims investigate how pavements and surface materials affects outdoor thermal environment during summer in tropical climate as Campinas, by use of infrared imaging analysis. It was select two urban street canyons in different density areas and east-west orientation. One has the relation height and width (H/W) equal 4.4 and Sky View Factor (SFV) is 0.23, and other has H/W equal 0.5 and SVF is 0.61. The predominant material of ground was stone, concrete, grass and asphalt, and the façades had structures made by brick, concrete blokes, stones and green walls. The infrared image was collected each hour, from 8 am to 17pm, during a summer period. Meteorological data as air temperature, relative humidity, wind velocity and solar radiation are also collected during the same period. It was interviewed 286 people about thermal sensation. The results demonstrated no significant temperature among several pavements and façades materials during the day. The infrared image shows the behavior of combination of different surface temperatures of pavement and façades and a correlation between high surface temperatures and heat stress. Analytical results indicate that the street with high H/W ratio causes more discomfort than street with low H/W ratio, due to Brazilians preference in walking above tree shade instead buildings. The correct application of pavement and façades materials in urban areas is a planning strategy for urban resilience and specifically adaptation of urban climate changes. The use of infrared images analysis can be a simple and practice to check the propriety of materials and their application.

KEYWORDS: *human outdoor thermal comfort, Sky view factor, physiologically equivalent temperature (PET), Infrared Images*

BEHAVIORS AND ADAPTATION OF HOUSEHOLDS LIVING IN AN OFF-GRID HOUSE

Dr Gabriela Zapata-Lancaster, Simon Lannon, Huw Jenkins

Welsh School of Architecture, Cardiff University

Off-grid living

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In the United Kingdom, the low carbon policy aspirations aim for new domestic buildings to be nearly zero carbon by 2020. In the past, the prevalent approach to low carbon performance has relied on the application of energy-efficient systems and low zero carbon technologies to offset the carbon emissions of buildings. However, research on performance gaps suggests that despite the good intentions of designers, the expected energy performance is rarely achieved during operation. Significant discrepancies have been found between as-designed and in-use performance, some of which may be the result of users' behaviours. Off grid buildings can give an insight into the potential onsite energy generation, storage and demand reduction. This article presents a study that analysed an off-grid house built in 2013 as a working farm house to Code for Sustainable Homes level 3 (level 5 energy). The off grid systems in this case study are analogous to an intermittent future energy supply. The study identified the energy-efficiency behaviours of the households and their adaptation in the off-grid house that has been occupied for over a year. The monitored data of in-use performance has informed the analysis of households' routines and practices that affected the energy and water consumption in the dwelling. The study suggests that the reductions in carbon emissions from the occupants' behaviour were limited in their impact as the parasitic loads of the systems dominate. The findings bring attention to a number of aspects that could affect the success of carbon reduction measures in dwellings.

KEYWORDS: *OFF-GRID, OCCUPANT BEHAVIOUR, ENERGY PERFORMANCE, LOW CARBON SYSTEMS*

RESHAPING CITIES AFTER A NATURAL DISASTER

Amedeo Scofone
WSP UK

Simos Yannas
Architectural Association School of Architecture

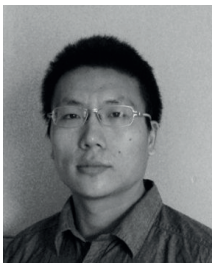
Plan of L'Aquila with the proposed development

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The paper presents a methodology for the building of permanent neighbourhoods following a natural disaster. The case of the 2009 earthquake in L'Aquila, Italy is taken as an example for illustrating the approach. The historical centre of the city was destroyed and new towns were built away from the centre following the catastrophe. The research project conducted by the author assessed the new developments looking at both the urban and dwelling scales focusing on environmental performance and social sustainability. It resulted in a set of generative rules for new urban patterns based on environmental design principles and closely following the context (climate and topography). The paper will present the alternative design proposals put forward by the study. These draw upon the traditional features of Italian hills town, -the narrow streets, small squares, and mixed-use building typologies-, aiming to provide good environments, indoors and outdoors, maintaining the high density of dwellings and activities.

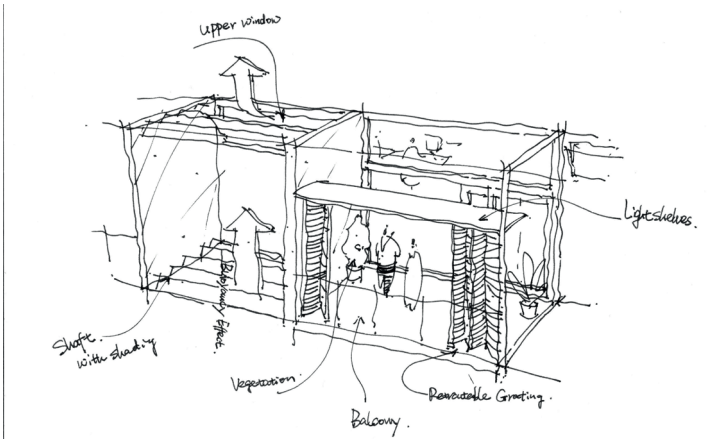
KEYWORDS: *Earthquake, Housing Emergency, Sustainable Development, fast urbanism*



THERMAL COMFORT FOR LOW CARBON OFFICE BUILDING IN SHENZHEN, CHINA: THEORETICAL DESIGN GUIDE FOR INTEGRATED ENVIRONMENTAL DESIGN IN HOT AND HUMID CLIMATES

Mingwei Sun, Benson Lau
The University of Nottingham

Brian Ford
NaturalCooling ltd



: *A sketch used in the design process to deliberate the facade system of the final design case.*

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The prosperous building market in south-east China, where suffers high temperatures and excessive humidity, is overly reliance on energy intensive mechanical building services with consequent high carbon emissions. The application of sustainability there is currently limited due to the complexity, not only of the local climatic conditions, but also of the city context, and the new skills and knowledge required of design professionals. This study describes a design methodology that shows the potential for sustainable architecture, through an iterative design process which focuses on achieving environmental quality in offices based on an understanding of seasonal and diurnal climatic variations. An integrated environmental design for improving the thermal performance of a generic office building is presented. This is primarily supported by a mixed-mode approach showing how natural ventilation can reduce the need for air-conditioning, while maintaining a comfortable interior habitat. Interrogated and supported by dynamic computational studies. The design proposal explores the evolution on internal environmental control strategy as well as a building form. Our findings conclude that, for over 80% of the working hours from October through April, adaptive thermal comfort can be achieved without the provision of mechanical heating or cooling services. A substantial reduction in energy consumption can be achieved compared with current practice, based on the design guide.

KEYWORDS: *Evidence based design, adaptive thermal comfort, natural ventilation and daylighting.*

UNSTEADY CFD SIMULATION OF THE URBAN HEAT ISLAND EFFECT IN A DENSE CITY ENVIRONMENT

Steven Tsang, Edward Ng

The Chinese University of Hong Kong

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

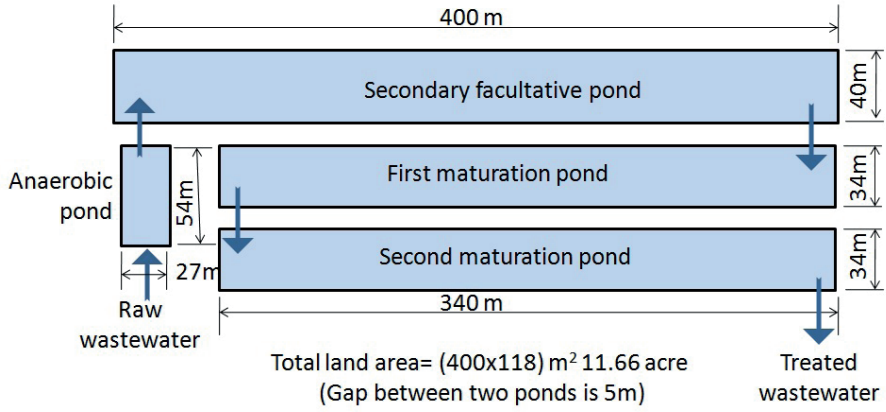
A CFD simulation is conducted to investigate the Urban Heat Island Effect. Most studies utilizing CFD to investigate the Urban Heat Island Effect neglect the importance of heat storage. Heat storage is the net amount of solar radiation and anthropogenic heat accumulated by the building and ground surfaces over several days. In order to investigate the heat storage, the microclimate around a dense urban city environment is simulated over a period of 4 days. The study area is Mongkok in Hong Kong, China. This is one of the most densely populated urban areas in the world. The combination of high building and population density offers unique opportunities for studying the Urban Heat Island Effect. Additionally it is located in the fastest growing urbanizing country in the world and offers a template for the future development of Asia. The Heat storage was found to significantly contribute to the Urban Heat Island Effect in dense building environments. High building density environments will exacerbate the Urban Heat Island Effect.

KEYWORDS: *Computational fluid dynamics, Urban Heat Island Effect, High Building density, Heat Storage flux*

SUSTAINABLE WASTE WATER TREATMENT IN DEVELOPING COUNTRIES: A CASE STUDY OF IIT KHARAGPUR CAMPUS

Sutapa Das, Sanjit Bokshi

RCG Infrastructure School, Indian Institute of Technology Kharagpur



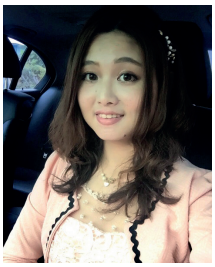
Schematic layout of the proposed WSP

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Treatment of wastewater and its reuse in irrigation and agriculture can mitigate the inevitable scarcity of safe drinking water in coming decades. For developing countries like India and especially in its backward regions, it is high time to focus on sustainable wastewater treatment which will be economical and easy to construct, operate and maintain by unskilled users without much dependency on electricity. Addressing this issue, various sustainable methods of wastewater treatment was critically analyzed and the Waste Stabilization Pond (WSP) system was selected. A facility was designed for 20000 residents of Indian Institute of Technology (IIT) Kharagpur campus based on its geo-climatic and wastewater characteristics. Detailed calculations were carried out to demonstrate the effluent quality with reduced BOD and E-coli is suitable for unrestricted irrigation. This project with minor customisation can act as a prototype for adjacent vast rural areas where land is available but water, electricity and skilled technicians are not. If implemented, this project will bear social benefits beyond campus such as water supply to drought prone areas, better harvest and rural employment. Moreover, it underpins government' several initiatives to develop rural infrastructure and inclusive growth of the country.

KEYWORDS: *Domestic wastewater, IIT Kharagpur, Rural infrastructure. Sustainability, WSP.*

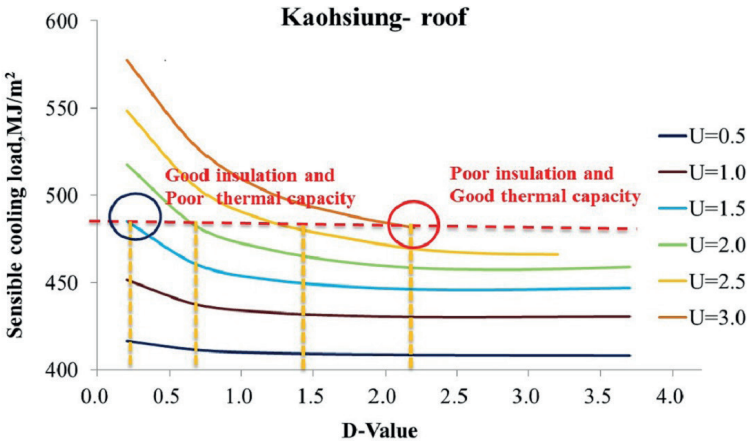


EFFECT OF THERMAL INSULATION AND THERMAL STORAGE OF EXTERNAL WALLS OF BUILDINGS ON AIR CONDITIONING LOAD

Wen-Mei Shih - National Cheng Kung University

Hui-Yan Liao - Architecture and Building Research Institute

Tzu-Ping Lin - National Cheng Kung University



Insulation and heat storage capacity equivalent effect

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study focus on the discussion how to integrate the thermal insulation with thermal mass of exterior wall to decrease the annual cooling load of office building in Taiwan, where has a climate of hot-summer and warm-winter. A typical office building was investigated in this study. By using the building energy simulation software, EnergyPlus, we determined the annual cooling loads of the investigated building with different combinations of thermal insulation (U-value) and thermal mass (D-value) of the external walls. And the simulation results were used for quantitative analysis of the effects of external walls' thermal mass and thermal insulation on annual cooling load. The benefits of combination of thermal mass and night ventilation on reducing HVAC energy consumption were also investigated in this study. The results of this study show that the annual sensible cooling load have a minimum occurred at U-value around 1.5 W/m2-K, while the annual cooling load decrease with the increment of the D-value. It validated to excessively increase the U-value is not always beneficial in the warm climate zone. The equivalent effect of U-value and D-value was evaluated in this study. An office building with night ventilation can save about 10 to 14% of the annual sensible cooling load. To increase the thermal insulation level of external wall has a positive contribution on saving annual cooling load; however, there is an optimal level. An external wall with high thermal mass level, especially with night ventilation, also makes a significant contribution on reducing cooling load. There is an equivalent effect between thermal insulation and thermal mass, so the two properties of external wall should be taken into consideration simultaneously in order to design an energy efficient wall for reducing the annual sensible cooling load.

KEYWORDS: *EXTERNAL WALL; THERMAL INSULATION; THERMAL MASS; COOLING LOAD*

HIGH DENSITY - HIGH PRIVACY - LOW ENERGY, RE-INTERPRETATION OF ‚COMPACT' COURTYARD HOUSING FOR SUSTAINABLE URBAN ENVIRONMENTS

Jan Cremers, Volkmar Bleicher
Hochschule für Technik Stuttgart (D)

Peter Bonfig
München (D)

Traditional Machiya courtyard (Kyoto), photograph by Jan Cremers

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

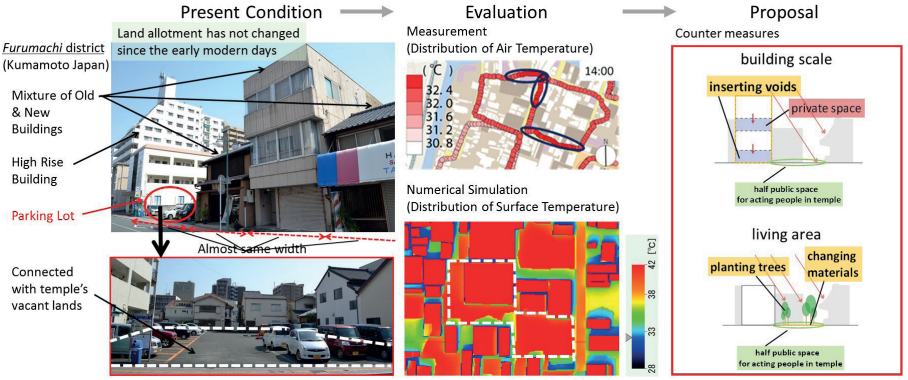
The widely neglected courtyard building type with a millennia-long tradition in many regions and climate zones stands for high density but also individual and flexible solutions with a high grade of privacy of space, indoors and outdoors. Contemporary new interpretations can provide extraordinary culture of dwelling, low energy consumption and sustainable development of social and urban structures. Research on these new compact types of courtyard buildings is a focal subject at Hochschule für Technik in Stuttgart (HFT), Germany. In this paper, results of two design studio projects are presented that have been run by the authors at University of Texas at Austin, School of Architecture (UTSOA), USA and Kyoto Institute of Technology (K.I.T), Japan. In each case, we have addressed advanced courtyard housing for urban areas, but for very different boundary conditions (climate, tradition, building technologies available, legal framework, plot sizes etc.). Common aims were optimised units using passive and active techniques at the state of the art, a maximum of density, privacy, flexibility of use, reduction of resources (land, material, energy) and cost efficiency. We also present our morphological and didactical/ pedagogical approach being part of the interdisciplinary and intercultural design process applied. The results show, that the new interpretation of very compact courtyard buildings allow for significantly higher densities and more privacy compared to traditional typologies - at a high level of architectural design quality, very high interior comfort, very low energy demand and also very high resource efficiency and interior flexibility. Also, due to the density and flexibility achieved, living space in these buildings can be significantly cheaper, especially in areas with high ground prizes. Therefore, this new type can be a chance to reduce urban sprawl with all its negative consequences known.

KEYWORDS: *BUILDING TYPOLOGY, COMPACT COURTYARD HOUSE, MACHIYA, LOW-RISE/HIGH DENSITY, URBANITY, FUTURE DWELLING, PRIVACY*

PROPOSAL OF UTILISATION OF EXISTING EARLY MODERN LAND ALLOTMENT IN THE REGIONAL URBAN CENTRE IN JAPAN FOR ACHIEVING IMPROVEMENTS IN THERMAL ENVIRONMENT

Tatsuya Kuriki (Graduate Student)
Masahito Takata (PhD,Assistant prof)

Kumamoto university Japan



Basic framework of this study

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In Japan, increases in the aging population along with the presence of vacant lands pose serious problems for many regional urban centres. In particular, hot summer nights caused by urban heat island phenomena are adversely affecting the health of the elderly population.

The Furumachi district, which is located in the centre of Kumamoto, is a major regional urban centre in Japan and an area where the problems described above are serious. One of the prominent features of this district is that land allotment of the city blocks has not changed since the early modern days, and therefore, all new developments are performed under this early modern land allotment. In this study, effective utilisation of the traditional land allotment was studied and proposed.

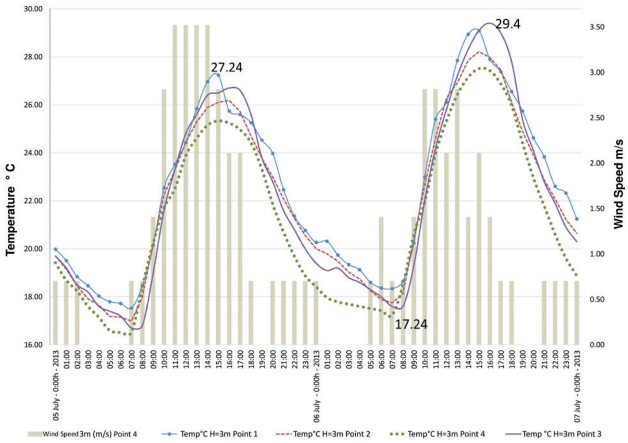
As a first step, the summer thermal environment of the target district was measured during surveys conducted from a bicycle. Two city blocks were studied in detail because they had poor thermal environments. Next, the distribution of surface temperatures along the two city blocks on the same summer day was reproduced using numerical simulations, and the outdoor thermal environment was evaluated from the surface temperature and mean radiant temperature (MRT) data. The results showed that the thermal environment was influenced by the presence of vacant lands in addition to open space parking lots, and modern buildings, and these factors interacted with one another. Finally, based on the results obtained, counter measures were proposed to improve the summer thermal environment and reduce heat island effects in the Furumachi district, such as changes to ground covers where appropriate and tree plantings. These changes may be feasible not to implement in vacant lots but to be applicable to other old castle towns in Japan.

KEYWORDS: *HEAT ISLAND PHENOMENA, REGIONAL URBAN CENTRE, SPATIAL STRUCTURE, MATERIALS, LAND ALLOTMENT*

EVAPORATIVE COOLING AS A RESOURCE OF AN URBAN OCCUPATION SCENARIO

Érico Masiero – Brasil

Léa Cristina Lucas de Souza
Federal University of São Carlos

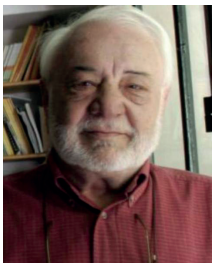


WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study analyzes the microclimate effects caused by a water body over an urban fraction on the São José do Rio Preto city, located at a Tropical Altitude Climate in São Paulo State, Brazil. It also proposes an occupation scenario of an area which is devoid of green infra structure taking advantage from the microclimatic potential of the urban evaporative cooling. It is assumed that the joint action between the air masses in the region, the evaporative cooling caused by the water body and the built environment can significantly improve the hygrothermal conditions of the urban environment. The study methodology is based on the physical characterization of different environments that make up the urban space, in determining the collection procedures of data fields, the analysis of macro and meso climate characteristics of the region, in the microclimatic treatment of data and formulating guidelines for urban occupation concept. The micrometeorological campaigns of data collection used fixed measurements points to the temperature behavior record, humidity, the direction and wind speed in the urban area, both in central areas as in the water reservoir banks in the inner city and the suburbs. Humidification urban air through the water body can reduce the daily temperature peaks at about 2°C, however, the significant difference detected in the temperature and humidity levels in the urban canopy layer clarifies that the 9 km² of the water reservoir are insufficient to influence the farthest outlying areas it under all weather conditions. As such, we propose an urban settlement scenario that leverages the penetration of humidified air masses, favors the passive action of the evaporative cooling and cause microclimate effects that mitigate the temperature range in little vegetated areas and in the excessively sealed city.

KEYWORDS: *Water body, urban ventilation, evaporative cooling, microclimate*



SUSTAINABLE REHABILITATION OF AN URBAN SPACE: THE GREEN LUNG IN HUELVA

Jaime López de Asiain, María López de Asiain

Seminario de Arquitectura y Medioambiente

Moret Park's inauguration

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

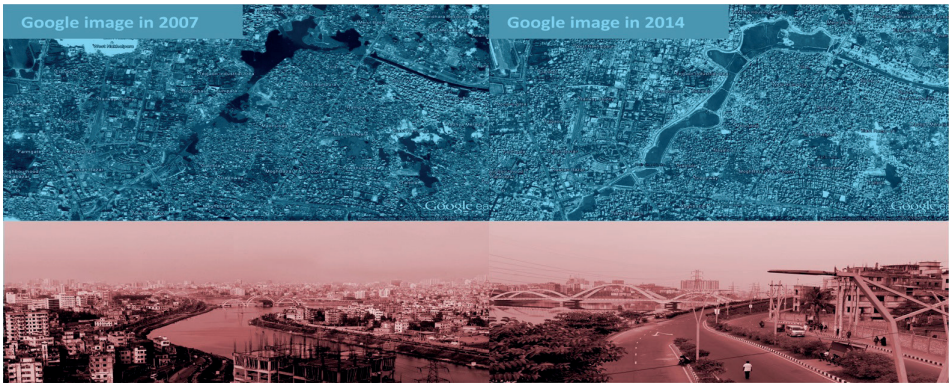
This article presents a case study in terms of Environmental design, social programming and public participation in peri-urban park Moret in Huelva, Spain. Moret Park is an example of participative management, the development of which may be of great interest for the rest of the local governments in Spain. The objective of the project is to create an urban forest, an exit to the countryside without leaving the city, encouraging the use and enjoyment of a privileged area that has been abandoned for decades. This has been achieved by giving value to a space with extraordinary environmental, landscape, natural and archaeological values, turning it into the green lung that Huelva needs. In Huelva, the lack of parks and green areas and the existence of activities that are especially aggressive to the environment resulted in a landscape that was unfriendly for the public. The enormous importance of the green lung not only arises from its intrinsic richness (various landscapes and uses, a multitude of species, archaeological and historic sites, etc) but also from the physical framework in which it lies, within Huelva, a city of almost 150,000 inhabitants and punished by pollution during recent decades. The green lung (72.4 ha) is in the very heart of Huelva, maximising the possibilities of using and enjoying it as a major resource for environmental education; it is a space for social cohesion and a rich historical-cultural site. Moret Park has also been a pioneering initiative of public participation throughout Spain concerning the entire process of creating and developing the park. The park's citizens' platform involves more than 30 citizens' associations who demanded the creation of an urban forest adapted to their needs. A continuous collaboration during the design process of the park through public meetings has allowed the physical and functional regeneration of the entire area and a real takeover of the park by the public in Huelva.

KEYWORDS: *SUSTAINABLE URBAN DESIGN, Co2 ABSORPTION, SOCIAL DESIGN, SOCIAL EMPOWERMENT.*

URBAN REGENERATION THROUGH RECONSTRUCTED WETLANDS AS AN URBAN DESIGN TOOL FOR RESILIENCE: CASE OF HATIRJHEEL-BEGUNBARI CANAL INTEGRATED DEVELOPMENT PROJECT IN DHAKA BANGLADESH.

Fahmid Ahmed

The University of Adelaide Australia



Google image of before and after the intervention including existing photographs of the site in 2014

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper demonstrates the process, rationale and consequences of reconstructed wetlands as an urban design tool in Dhaka Bangladesh. Dhaka is situated in the largest delta system in the world with an extraordinary pace of urbanisation and the city has more than fifteen million people. In Dhaka managing water in urban development became a major issue in planning and design. The county is one of the most vulnerable in terms of climate change scenario as a big portion of the total population lives just few meters above the sea level with frequent extreme weather events. Besides, due to the landfills for urbanisation in the major cities; and destruction of natural wetlands and drainages including canals, flood plains, fore shores and other water bodies have been causing environmental disasters in the forms of flash flood, pollution, collapse of buildings, shortage of drinking water, obliteration of biodiversity etc. The research critically examines the urban water intervention as a planning and design initiative to comprehend the issue of sustainability in the context of Dhaka. Hatirjheel-Begunbari canal integrated project in Dhaka is the major case for analysing the reconstructed wetlands that is one of the largest urban development projects in the city in the recent history. This project claims to be one of the most successful projects in the recent times in terms of urban water intervention which includes drainage, open space, pedestrian and vehicular circulation, water retention and other urban design elements. This paper explains the development logics and post-construction scenario of the project from an urban design spectacle.

KEYWORDS: *Dhaka, Reconstructed Wetlands, Hatirjheel-Begunbari Canal, Plan Making Process.*

IMPACT OF MOVABLE EXTERNAL SHADING SYSTEM ON DAYLIGHT AVAILABILITY OF OFFICE BUILDING IN HOT AND DRY CLIMATE OF INDIA

Chinmay Patel
CEPT University

Rajan Rawal, Agam shah, Yash Shukla
CARBSE

Exterior and interior view of the primary case study, Safal Profitare, Ahmedabad, India.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

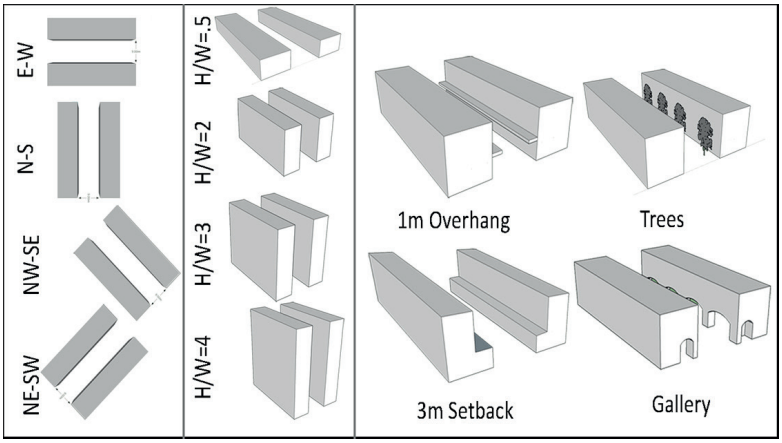
As our fast interdepended global world enters the depth of the 21st century, everyone's immediate attention is to mitigate climate change by various means. One of the proven methods to address climate mitigation is to reduce energy consumption in buildings. The war with global energy crisis is getting intense every second we breathe. Over all buildings account for approximately 40% of global energy consumption (1), most of which is used in making buildings comfortable. Heating Ventilating and Air-conditioning systems (HVAC) and electric lighting does take significan portion of total operational energy consumption. Various materials have influenced architectural aesthetics in recenttimes. Glass is one of them. Uses of glass in fenestration without any shading strategy have adversly affected energy consumption of building. In the current architectural scenario in the country it can be observed that commercial buildings are largely becoming energy intensive in nature, which means that a lot of energy is used in cooling, lighting and running the equipment In this context(2). This study focuses on shading strategy and a solution which meets current requiremeht of architectural aesthestics, possibility of scaling them up and its cost effectiveness. By adding a dynamic shaidng skin over the building's envelop static skin can lead to drastic reduction in energy loads and increasing thermal and visual comfort at the same time.. Keeping materials, finishing and geometry into consideration the design possilities are immense and can indulge the deisgner in varied possibilities. Study provides insight into visual and energy performance of shading devices. The study relies on field measurements and numerical calculations to understand its effectiveness.

KEYWORDS: *Daylighting, dynamic shading device, louvers, office building, hot and dry, India,*

OPTIMIZED STREET DESIGN TO BALANCE OUTDOOR THERMAL COMFORT AND INDOOR DAYLIGHTING PERFORMANCE WITHIN LARGE SCALE URBAN SETTINGS IN HOT ARID CLIMATES

Rania-Labib, Liliana-Beltran

Texas A&M University



Three groups of four different street configurations.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

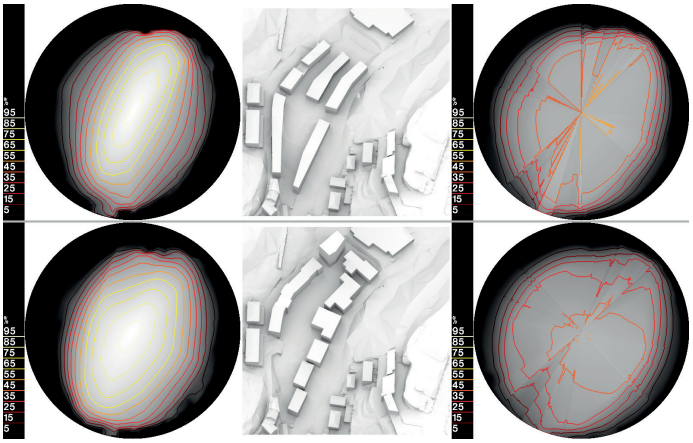
Due to rapid urbanization in developing countries, achieving better outdoor thermal comfort has gained an elevated level of attention, especially within urban settings in hot climates. Although many research studies have focused on improving outdoor thermal comfort in urban settings and many researchers have discussed the influence of a building's geometry on the availability of daylighting in indoor spaces, there has been very little focus on street design as a means of improving both outdoor thermal comfort and indoor daylighting. This research study examines street design within urban settings in order to find a balanced design that could lead to better day-lit indoor environments and improve pedestrian thermal comfort. A series of quantitative simulations of various street configurations - such as street orientation and the ratio of building height to street width – have been performed. In order to find a balanced street configuration that achieves a comfortable outdoor environment and better day-lit indoor environment, the simulation results have been plotted and compared. The results show that the use of overhangs and galleries could achieve the desired balanced result.

KEYWORDS: *Daylighting, outdoor thermal comfort, urban daylighting*

ASSESSING DAYLIGHT AND SUNLIGHT ACCESS IN THE BUILT ENVIRONMENT: A NEW TOOL FOR PLANNERS AND DESIGNERS

Raphaël Compagnon
HEIA-FR

Giulio Antonutto, Paula Longato, Alexander Rotsch
ARUP



so called "multishading mask" stereographic pictures indicate the percentage of an area that is unobstructed toward each direction on the sky vault. This figure compares two different urban designs.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The need for densification in cities creates a challenge for designers and policy makers in order to provide sufficient access to daylight and sunlight to buildings and to the open public spaces in-between. Guidance and policies should provide site specific recommendations and targets to designers and developers to allow for an optimal dimensioning of the massing for new development. This guidance should be based on the local climate and specific to the site. At the core of this guidance should be an objective method of assessment based on climatic data with flexible targets.

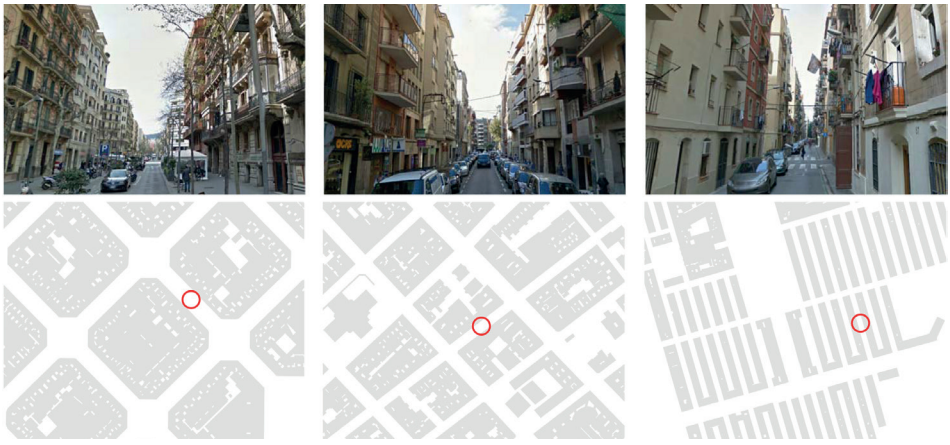
The proposed method is based on "multishading masks" (Fig. 1) or "effective envelope area pictures" which are two different ways of "mapping" the visibility between buildings' envelope or the open spaces and the sky vault. These are later processed to compute a set of quality indicators that can be used to compare proposed massing configurations and select the most efficient ones. Some of these indicators such as the Sky Component are independent from the site while others such as the Potential or Actual Sunlight Exposure are latitude or site specific respectively.

KEYWORDS: *SOLAR ACCESS, SUNLIGHT EXPOSURE, OPEN SPACES, URBAN FORM, SHADING MASKS, SKY VIEW FACTOR*

CHARACTERIZATION OF SOLAR ACCESS IN MEDITERRANEAN CITIES: ORIENTED SKY FACTOR

Elena Garcia-Nevado, Anna Pagès-Ramon, Helena Coch
School of Architecture of Barcelona

Benoit Beckers
Compiègne University of Technology



Barcelona urban fabrics. From left to right, basis for typological street models A, B and C

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The link between city morphology and urban energy consumption, although proved, requires further research. In that sense, the analysis of parameters describing the urban texture may be a useful approach for energy assessment at a city scale. Some geometrical parameters have been used to study urban energy aspects related to the radiative phenomena, such as heat island or even a rough indicator of solar energy availability in locations where direct radiation is not determining. This paper aims to explore the correlation between one of these parameters -the Sky Factor (SF)- and direct solar radiation over facades, as a characterization tool of solar access within an urban context. Barcelona, a Mediterranean city where direct sunlight and the built environment density are deciding factors, has been chosen as case study. At different points of the facade for several urban canyons, SF value and direct solar radiation for different orientations and times of the year have been computed using Heliodon software. Both results have been related one to another and it has been found that, for a specific latitude, it is possible to define a smooth dependence between these parameters, if the orientation is taken into account. This paper shows that, beyond the SF threshold of 0.42, direct solar radiation on the facade reaches an almost asymptotic value for all orientations and times of the year.

KEYWORDS:*Sky Factor, Solar Radiation, Urban morphology, Mediterranean environment*

REHABILITATION OF PORT AREA

Ana Costa, Danielle Gruimarães

Universidade Federal do Amapá

proposal for urban rehabilitation to the port area of the Igarapé das Mulheres, Macapá-AP, Brazil.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The fast and uncontrolled urban growth, resulting from the lack of an efficient and broad housing policy in most Brazilian cities, is one of the main factors that lead to the emergence of degraded areas. Such urban areas that have developed without adequate planning, without the required public administration attention and, therefore, unattractive, tend to have less quality in infrastructure and basic sanitation, what can affect social and environmental welfare. When this situation occurs in consolidated areas is even more complex to solve. This work is part of a study about Igarapé das Mulheres, a small port area, located on the edge of the Macapá city, in northern Brazil. There are precarious housing in very poor conditions, visual and environmental pollution and several problems of urban infrastructure. In this study, the solution is intended for interventions urban and consists of a complementary and mul-tidisciplinary research about urban environments that need to be recovered, about the population and the local dynamics. The proposal to the area consists in the urbanization with road traffic readjustment, in a creation of a different housing development and in the port area rehabilitation as well as in the in-sertion of buildings and infrastructures that serve existing on-site activities. In general, this work pre-sents an applied research for urban regeneration and its innovations in the Amazon context. Seeks to enable local usage, to structure, to rehabilitate the surrounding recreational areas, to provide environ-mental quality and to value the local identity.

KEYWORDS: *Urban Regeneration, Urban Design, Igarapé das Mulheres, Social Challenges.*

RESHAPING THE URBAN BLOCK IN ATHENS

Byron Mardas, Simos Yannas

Architectural Association School of Architecture

illustration showing a "reshaped" Urban block, as an attraction for outdoor life

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Life outdoors constitutes a large part of Athenian culture and it defines the way both citizens and tourists experience the city. Knowing that urban geometry can affect the microclimate of a city and studying the urban form of the Athenian centre, this study intends to devise alterations on the urban form that will improve this microclimate. For this paper a series of blocks have been both measured during field work, and simulated using several tools, to better chose the most promising urban block configuration.

Important findings include that rectangular blocks with higher permeability result in reduced air temperature. Although surface temperature are lower as well, there is proof that further shading is required. Shading devices will be introduced within this study to identify their potential and effect.

KEYWORDS: *OUTDOOR COMFORT, URBAN FORM, URBAN MICROCLIMATE, URBAN BLOCK.*

15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Post Carbon Cities

2nd Parallel Session

DAY 2

10:30 – 12:30

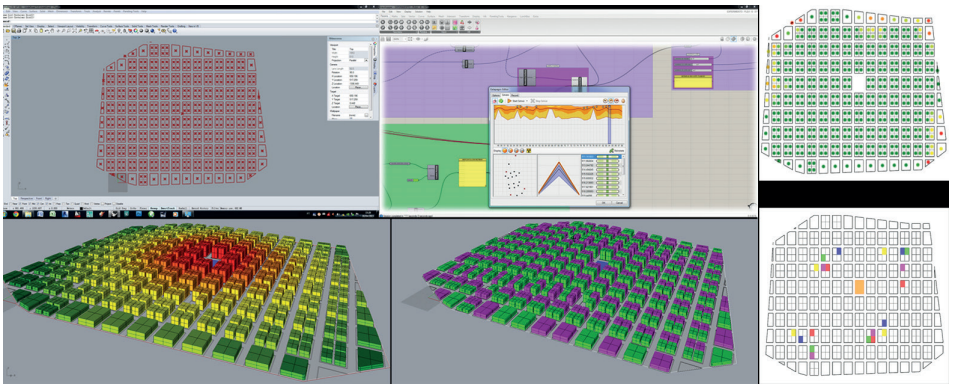
CHAIRMEN

Joana Gonçalves ..... Table 4
Gianni Scudo ..... Table 5
Filippo Weber ..... Table 6

ALGORITHMIC APPROACH FOR TRANSIT ORIENTED DEVELOPMENT: COMPUTATIONAL OPTIMIZATION IN SUSTAINABLE CITIES PROPOSALS

Fernando Lima
Universidade Federal de Juiz de Fora

José Kós, Rodrigo Paraizo
Universidade Federal do Rio de Janeiro



Algorithmic modelling and optimization tools towards more efficient TOD proposals

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Transportation is one of the largest carbon emitters on the planet. Besides contributing to global warming, it is responsible for huge obstacles in large urban centers. Therefore, developing better solutions, with varied approaches, for urban mobility has become increasingly important. On the other hand, computational design and algorithmic-parametric procedures are contributing to change design methods, as they provide ways of exploring multiple solutions – including optimization tools to indicate solutions with better performance. Transit Oriented Development (TOD) advocates the creation of mixed use neighborhoods within walking distance to a variety of transportation options and to commercial and educational amenities, so that the basic urban needs are easily accessible, promoting a more sustainable organization for cities. The key principles for TOD efficiency are: (a) transit accessibility – neighborhood development around transit hubs; (b) walkability - pedestrian-friendly street networks that connect local destinations within walking distance of transit stops; (c) Diversity - mix of uses, densities, housing types and costs in the same district; (d) articulated density for mass transit - infill and redevelopment along transit corridors within existing neighborhoods. In this sense, TOD design is multivariate dependent, as long as it relies on geometric and measurable parameters for improved performance. In other words, it is essentially programmable, an ideal case for algorithmic logic implementation. This paper describes an experiment with TOD design using algorithmic modelling. In this sense, this work goes towards a sustainable urban design practice that arises from employing algorithms and their ability to use complex calculations and parametric features to enhance TOD design methods.

KEYWORDS: *Algorithmic logic, Transit Oriented Development, Optimization.*

A STUDY LOOKING AT FACTORS TO CHARACTERIZE THE RESIDENTIAL ENERGY CONSUMPTION PATTERNS IN MONTEVIDEO, URUGUAY

Alicia Picción, Magdalena Camacho

Facultad de Arquitectura, UdelaR

Types of residential buildings in Montevideo

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The energy consumption in buildings for the different services depends on many components (climate –equipment- control- user) and their interrelationships. The third part of final energy consumption in Uruguay occurs in the residential sector. This paper presents a study on the factors influencing energy consumption in households in Montevideo, especially those related to the user, as part of the research "Equity and Energy in Uruguay. Interdisciplinary analysis of energy demand comes in the residential sector in Montevideo". The aim is to contribute with the discussion of the socioeconomic aspects involved in energy policy. On these factors and their interrelationship this team has found no record in Uruguay. From international studies can be identified a group of basic variables that allow to define the behavioral patterns and user profiles. Those variables are analyzed with statistical methodology, known as Classification and Regression Tress that permits to find groups with similar household characteristics. A selection of cases is made in order to obtain a convenience sample to do the fieldwork, which consists on interviews, polls, measurements and surveys of constructive buildings characteristics. It is observed that consciousness about energy consumption is stronger in low income households than in homes with higher incomes. The awareness of energy consumption is more related with individual interest of each person than educational level reached. It is also observed that electricity is the most used source in all households although exists the possibility to use other sources, even less expensive.

KEYWORDS: *Energy consumption patterns, residential sector, socioeconomic factors*

TOWARD SUSTAINABLE REGENERATION OF DISUSED URBAN AREAS: A MONITORING TOOL TO INTEGRATE ASSESSMENT INTO THE PROJECT DYNAMICS

Martine Laprise - Laboratory of Architecture and Sustainable
Sophie Lufkin - Technologies (LAST), Ecole polytechnique fédérale
Emmanuel Rey - de Lausanne (EPFL), Switzerland

The Gare-Lac neighborhood, a disused urban area in Yverdon-les-Bains (Switzerland)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Regeneration of disused urban areas, such as industrial brownfields or abandoned infrastructural zones, has received considerable attention in the context of post-industrial European cities. Indeed, these projects offer great opportunities for the densification and revitalization of the existing built fabric as well as for the limitation of urban sprawl. By addressing the neighborhood scale, initiatives of this type can potentially have global positive impacts on environment, economy and communities of cities and are becoming strongly fostered by land use policies.
Despite all this, due to the inherent complexity of urban regeneration projects, a holistic integration of sustainability objectives is far from being an automatic process. It depends upon a proactive search for global quality, integrated in a participative way in the project dynamics and a structured and continuous assessment of environmental, economic and social dimensions of sustainability, tailored to the specificities of such projects.
Specifically focusing on these challenges, the ongoing research presented in this paper aims at developing a monitoring tool entitled SIPRIUS+. This new generation tool is a hybrid between a sustainability indicator system adapted to the issues raised by the regeneration of disused urban areas and a user-friendly, web-based monitoring software. SIPRIUS+ is designed to provide a strong basis to key stakeholders involved in the management of these projects and facilitates communication and participation with various public or private actors.
This paper gives an overview of these objectives and a description of the steps of the tool's design. Preliminary findings leading to future adaptations are presented through a case study: the Gare-Lac neighborhood, a large disused urban area located in the city of Yverdon-les-Bains (Switzerland).

KEYWORDS: *DISUSED URBAN AREAS, URBAN REGENERATION, SUSTAINABILITY ASSESSMENT, INDICATOR SYSTEM, MONITORING TOOL.*

CONTEMPORARY PASSIVE SHELTERS: CHANGE OF PERSPECTIVE ENVIRONMENTAL DIVERSITY AND CONTEMPORARY LIFESTYLES

Arch. Filippo Weber, Dr. Rosa Schiano-Phan

University of Westminster

Architectural concept

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Currently, buildings use large amounts of their operational energy to counteract the impact of the external environment on their inhabitants. Recent years have seen a progressive attention on these themes due to the great energy saving potential of the sector, moving towards an integrated design approach between the building and its plants. Nevertheless buildings, although more efficient, are still conceived as containers of mechanically controlled microclimates. However, today, technology and new theories of comfort allow a radical rethinking of how buildings are conceived, designed and inhabited.

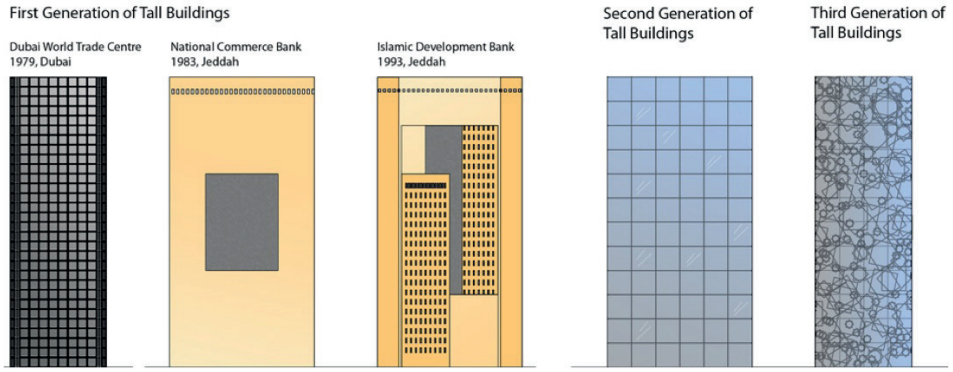
This paper reports on a design research that investigates alternative models of habitable environments, proposing an original concept and role for buildings. The research aims to contribute to the discourse on new highly efficient buildings showing how an innovative design process based on the integration of adaptive comfort theory, building physics and thermodynamic principles, passive strategies and centrality of the user, can not only deliver less energy intensive and more comfortable buildings but also enhance the generative potentials of new forms and spaces towards a more contemporary and sustainable built environment.

KEYWORDS: *ENVIRONMENTAL DESIGN, ADAPTIVE COMFORT, SURROUNDING-BUILDING-USER SYSTEM, SPATIAL DIVERSITY, NEW LIFESTYLES AND NEW BUILDING CONFIGURATIONS*

ENERGY EFFICIENCY IN RESIDENTIAL TALL BUILDINGS OF THE GULF REGION: TRENDS AND SOLUTIONS

Noura Ghabra, Philip Oldfield, Lucelia Taranto Rodrigues

University of Nottingham



WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The city of Jeddah in Saudi Arabia is currently witnessing a tall building construction boom associated with many environmental and ecological challenges that are linked with increased energy demand. The significant use of air conditioning to cool indoor spaces, particularly in residential buildings, accounts for more than half of all energy consumption in the country. Despite governmental efforts, the scattered conservation efforts have been largely ineffective due to factors such as bureaucracy and lack of awareness and information, in addition to the political challenge of curtailing subsidies. A further barrier to energy conservation is the limitation of local building energy codes; these focus primarily on setting appropriate figures for building envelope parameters, such as glazing and wall thermal transmittance values, with little consideration of the broader architecture and design parameters that influence building performance – such as shading, balance between transparency and opacity and building form and organisation. In this paper, the authors question the limitations of the current façade design approaches and building regulations for residential tall buildings in the Gulf Region. The aim of this study is to compare common high-rise facade design strategies of tall buildings in the region, in order to identify the most promising and least promising arrangements. To achieve this aim, a representative existing case study of a residential tall building in Jeddah, Saudi Arabia, was dynamically simulated and compared to other cases in a parametric study. The study focused on three building envelope parameters (glazing percentage, wall construction and glazing types). The results of the study defined the limitations of the current façade design approaches and building regulations in the Gulf Region, and encouraged further façade design considerations to be implemented to induce greater energy performance and improve indoor environments in this building type.

KEYWORDS: *Tall buildings, energy efficiency, building envelope, façade design, building codes*

USEFULNESS AND EFFECTIVENESS OF RETENTION LAYERS IN GREEN ROOFS

Emanuele Habib - Sapienza Università di Roma, DIAEE area Fisica Tecnica

Gioia Clementella, Carlo Cecere - Sapienza University of Rome, Department of Civil Engineering, Building and Environment

Morgan Processing and Distribution Center, New York, USA, the largest green roof, 2.5 hectares

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Green roofs are an emerging technology for urban climate mitigation, rain-water management and energy saving. Even though they are long time used, there are not much data on the relation between its construction and performance for lightweight extensive systems in Mediterranean climate. This is particularly relevant for existing buildings as the opportunity of converting conventional roofs in green ones is limited by the extent of the new applied loads. The most part of the mass of these systems is due to cultivation substrate and retention layer, thus proper design would let a wider adoption of this technology. Moreover, data available in the open literature are mainly referred to northern temperate zone where drought periods are of little concern.

In this framework, experimental light load (80 mm substrate) green roofs have been built up to check their performances in Mediterranean climate (Rieti -inner central Italy) with different retention layers. Drainage performance have been measured in natural weather as well as qualitative analysis of vegetation endurance to draught periods with a specific focus on the relevance of retention in drainage layer.

Results show that, contrary to state-of-the-art statements, water retention actually occurs more in the substrate rather than in the retention layer that thus appears to be far less critical in green roof systems set up.

KEYWORDS: *Green Roofs, Rainfall retention, Building renewal, Green Infrastructure*

THE SUSTAINABLE PROJECT OF A MODEL SUPERMARKET FROM DESIGN TO OPERATION

Angelo Mingozzi, Sergio Bottiglioni

Ricerca e Progetto -
Galassi, Mingozzi e Associati

the new supermarket and its public spaces

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper describes the innovative and successful case of a new model supermarket designed, built and operated in strict compliance with sustainability principles, showing how a commercial investment can be the occasion for a wider process of urban regeneration.
A structured process was developed with the following main phases: new criteria were defined to evaluate energy and environmental quality of food retail stores; clear and measurable targets for energy and resource savings were set in advance; the actual supermarket was designed and built; performances were checked and adjusted during three years of activity through a building automation and control system.
In coherence with the local context, the project addressed sustainability issues with a comprehensive approach. The result has been not only the creation of a neighbourhood supermarket with outstanding performances in energy efficiency and comfort, but also the redevelopment of a blighted urban area into an attractive centre with public spaces and pedestrian and bicycle paths, as well as the stimulus for customers and employees to learn and adopt environmentally friendly behaviours.
An accurate and systematic control of measurable parameters proves that the actual performances fully confirm what expected: in particular gross energy needs, including food refrigeration, are 46% lower compared to an existing ordinary supermarket having the same size, in the same climate.
This project is not supposed to be a unique instance, but it's just a paradigm for others to be designed with the same criteria, applying customised solutions to specific local features.

KEYWORDS: *URBAN REGENERATION, THERMAL COMFORT, BIOCLIMATIC APPROACH, SUSTAINABLE SUPERMARKET, ENERGY EFFICIENCY*

URBAN GEOMETRY AND URBAN ENVIRONMENTAL EVALUATION FOR POLICY DEVELOPMENT IN MONTREAL

Yupeng Wang - Chengdu University, China
Concordia University, Canada

Hashem Akbari - Concordia University, Canada

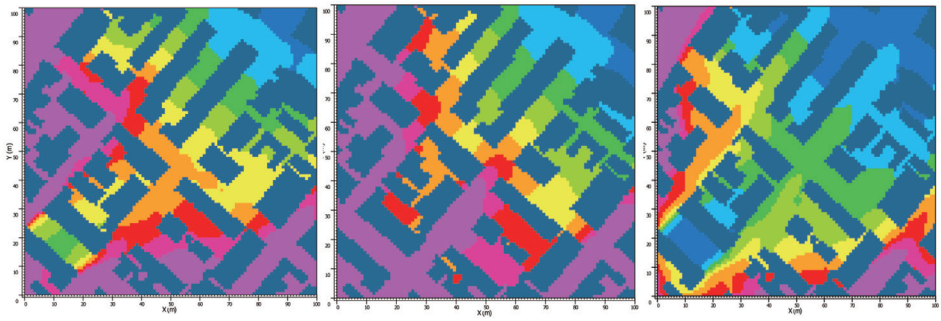


Image of urban air temperature

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The increasing awareness of the urban heat island (UHI) effect has raised attention to monitor and evaluate the outdoor thermal comfort in cities worldwide. Research carried out in eight Canadian cities compared observed number of annual hot days (with a temperature high of 30) between 1961 and 1990 to the forecasted average after 2020 will be increased from 10 to 22 days. Projected temperature increases in Canada are even more dramatic than in the southern latitudes. Currently, in Canada, some municipalities have discussed UHI mitigation at strategy level, carried out literature review, revealed current status of UHI impacts in Canadian cities on energy consumption, citizen wellbeing and health. However, there is little discussion about detailed technical guidelines for UHI mitigation application.

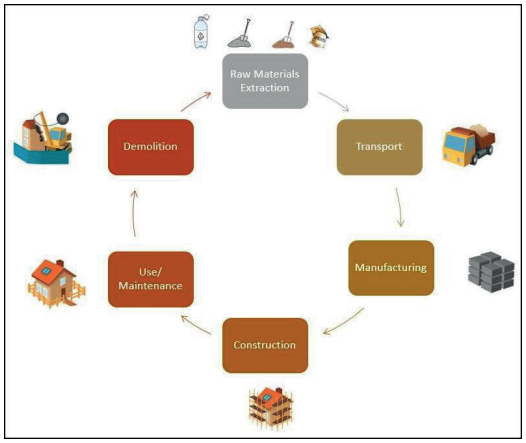
In this paper, we provide an urban development policy for SVF control, and evaluate the effects on urban geometry change and urban thermal environment. The micro-scale urban environment simulation system ENVI-met is used to compare the results under various policies of controlling floor area ratio, building set back, and land coverage ratio, between specified urban geometry changes. The simulations were carried out in the central area (300m by 300m in size) at Montreal. The Ta and MRT at 1.8m height above the ground were compared and evaluated. These technical analyses contribute to environmental policy development for UHI mitigation.

KEYWORDS: *URBAN HEAT ISLAND; URBAN TYPOLOGY; SIMULATION; OUTDOOR THERMAL COMFORT*

CONCRETE BRICKS WITH THE ADDITION OF RECYCLED POLYETHYLENE TEREPHTHALATE (PET), AS A SOLUTION FOR A SUSTAINABLE MATERIAL FOR CONSTRUCTION INDUSTRY

Josefina Infante Alcalde - América Solidaria

Claudia Alejandra Valderrama Ulloa , Ana Maria Carvajal Guerra, Andrés Solas Aguirrebeitia - Pontificia Universidad Católica de Chile



Life Cycles Analysis (LCA) of the concrete bricks with recycled PET.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Waste generates a large impact on the environment, most significantly the impact of slow degradation waste such as plastics, in Chile indicate that only 4% of plastics are recycled, a really alarming figure. Concrete is extensively used the world over in construction works and it is one of the most heavily used housing materials because of its excellent seismic and strength characteristics. However, its use involves big environmental costs, particularly the enormous amounts of energy consumed and CO2 emissions generated during its manufacture.

The research methodology consisted in learning in a theoretical way about the social, economic, technical and environmental impact of this material. The study calculated its cost and compared it to the cost of other masonry products. On the technical side, Rilem test tubes were prepared with 5%, 10%, 15% and 20% PET dosages, to be tested for bending, compression and chloride penetration.

Is concrete brick with the addition of recycled PET, a viable material in harmony with the three essential pillars of sustainability: social, economic and environmental and may contribute to technological innovation in the Chilean construction industry?

KEYWORDS: *Polyethylene Terephthalate PET, sustainable, Life Cycles Analysis (LCA), carbon footprint.*

ENERGY RETROFIT ALTERNATIVES FOR MULTIFAMILY RESIDENTIAL BUILDINGS IN ISRAEL

Daphna Drori, Abraham Yezioro, Edna Shaviv

Faculty of Architecture - Technion IIT

View of a number of neighborhoods in Ashdod - Cohen, 1966 (Bezalel-architecture, 2015)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

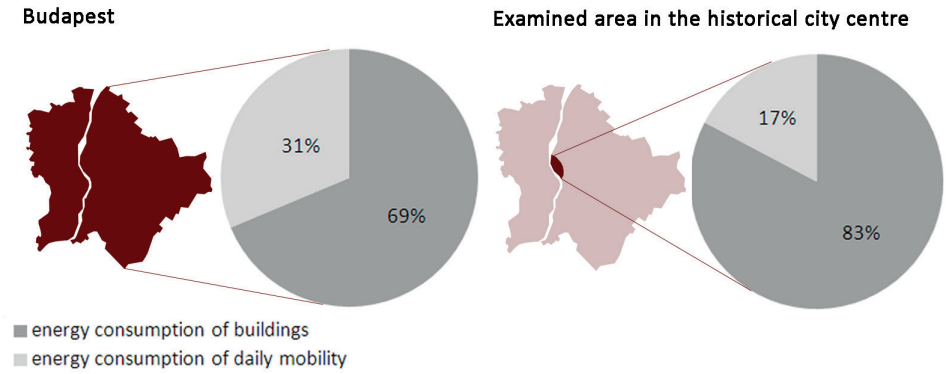
Due to the massive number of multifamily residential blocks and their current condition, the energy retrofit of 60-year-old residential buildings is essential. "TAMA38" is an Israeli national master plan which has been dealing over the last decade with the retrofit and reinforcement of residential buildings to make them earthquake resistant. The study questioned the potential of TAMA38 to include a green retrofit and thus become a holistic sustainable process. To investigate this idea we performed simulations on a case-study of blocks of row buildings. The energy saving was calculated using different alternatives, regarding the Israeli Energy Rating of Buildings Standard (SI5282, 2011). These include: a. Low-E without external shutters b. Night ventilation c. Improved Insulation d. Improved Insulation & night ventilation e. TAMA38 F. Green TAMA38. The Green TAMA38 retrofit includes earthquake reinforcement, enlargement of the post-war small apartment, and adjustment to up-to-date standards including the addition of an elevator. Results indicate that a Green TAMA38 effectively responds to various local interests: instead of insulating the old roof and the southern walls, a new floor and rooms with sunspace are built, turning it into a sustainable building. The Green TAMA38 retrofit of existing buildings minimizes the use of building materials and non-renewable resources resulting in a decrease in energy consumption and pollution. The assets of the energy retrofit are realised not only by amending the occupants' quality of life within an enlarged renovated apartment, but also by empowering the surrounding neighbourhood and the urban fabric. Green TAMA38 can be a holistic optimal solution, beneficial and economical also in other countries around the world.

KEYWORDS: *ENERGY RETROFIT, HOLISTIC RETROFIT APPROACH, BIOCLIMATIC DESIGN, EXISTING MULTIFAMILY ROW BUILDING, SUSTAINABLE BUILDING*

EMBEDDEDNESS OF HISTORICAL CITY CENTRES: THE RELEVANCE OF SOCIO-ECONOMIC TRENDS AND URBAN MOBILITY PATTERNS IN BUDAPEST

Réka Tóth
ABUD Ltd., Budapest, Hungary

Dr. Melinda Benkő
Department of Urban Planning, BUTE



Ratio of residential energy consumption in Budapest (SEAP, 2011) and in the examined blocks

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The future of historical urban centres is deeply interwoven with the criteria of sustainability. The concept of a "Zero-Energy Neighbourhood" has garnered increasing interest in recent years with the commencement of investigations into the main factors determining the energy balance of a neighbourhood (energy consumption of buildings, impact of location on energy consumption for daily mobility, and use of renewable energy sources). Hence, it is clear that historical city centres require special attention. The analysis should be based on socio-economic trends and the existing underlying structure of these districts with their favourable density and social and functional diversity. Within this framework, the overall object of the study is to define, through the analysis of three historical urban blocks in Budapest, the present energy use patterns of Budapest's central area with the people's needs and local context as a starting point. A deep survey analysis was performed exploring the connection between building energy use, the socio-economic composition of the neighbourhood, and the travel patterns of residents. Also explored is the need for more attention to be paid to the social regeneration of these historical urban blocks, as well as the need for integrated approaches. As a result, the study proposes to address the energy consumption of neighbourhoods that takes into account the socio-economic characteristics of the given districts. To demonstrate this idea, we define 'embeddedness' as an objective value of the neighbourhood.

KEYWORDS: *HISTORICAL CITY CENTRES, MOBILITY, EMBEDDEDNESS, NEIGHBOURHOOD ENERGY CONSUMPTION*

MATERIALS SELECTION FOR IMPROVED INDOOR AIR QUALITY IN RESIDENTIAL BUILDINGS: A PRE-OCCUPANCY ASSESSMENT

Dalia Wagdi, Mohamed Nagib Abou-Zeid, Khaled Tarabieh

The American University in Cairo

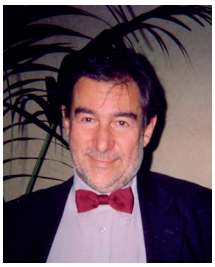
IAQ assessment in residential buildings

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Materials selection and design decisions are factors that determine the quality of the built-environment. Construction materials contribute to the emission of indoor air pollutants, which exposes occupants to multiple pollutants simultaneously. Since human health and safety are two core values in sustainable development, acceptable Indoor Air Quality (IAQ) standards should be defined. In Egypt, defining benchmarks is necessary to help alleviate the adverse health effects due to these emissions. The goal of this work is to investigate the impact of the built environment, namely, construction materials on IAQ. This will be carried out by quantifying air pollution levels in a steady state, controlled environment and by examining the effect of source control in the reduction or elimination of pollutants. IAQ is monitored in nine locations at the preoccupancy stage and an evaluation scheme (IAQ index) is designed and applied to compare the quality of air in the tested rooms. The monitored parameters include particulate matter (PM 2.5, PM 10), Volatile Organic Compounds (VOCs), Formaldehyde (HCHO), Ammonia (NH3) and Radon Gas while observing indoor and outdoor temperature and relative humidity. The indoor air pollution levels indicated by the proposed index have shown poor air quality immediately after the completion of construction, however, it improves in locations monitored 6 to 12 months after construction. The period after construction, age of the building and type of construction materials affect the indoor pollution levels. The results indicate that IAQ in residential buildings can improve with proper selection of materials during design stages, applying assessment tools and specifying proper standards for hot, arid climates.

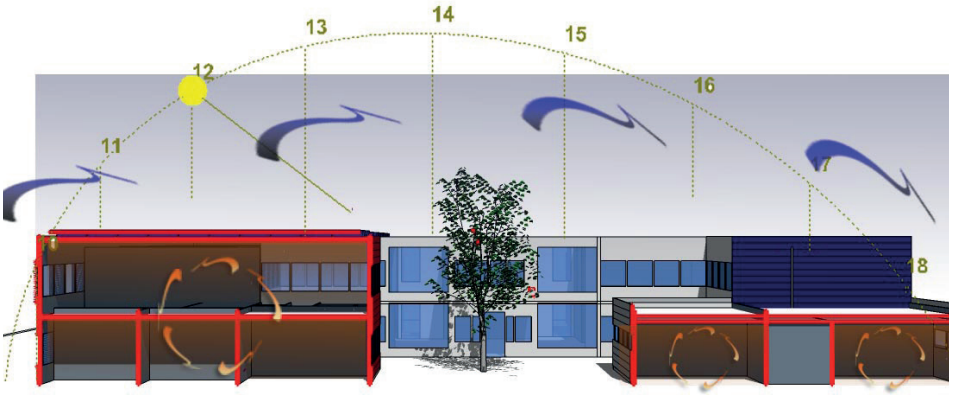
KEYWORDS: *Indoor Air Quality, Construction Materials, Residential buildings, IAQ index.*



A GREEN SCHOOL FOR THE MED AREA: THE RESPONSIBLE RETROFITTING OF THE HIGH SCHOOL VALLISNERI IN LUCCA

Prof., Arch. Marco Sala, PhD, Arch. Rosa Romano

University of Florence, ABITA Research Centre



Bioclimatic section of Vallisneri School

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Schools and academic buildings represent 17% of the European stock of buildings and approximately 12% of average, non-residential, energy consumption in Europe. Europe's school building stock is relatively old, often dilapidated and has poor energy performance. The European Energy Efficiency Directive (27/2012/EU) provides that, from 1 January 2014, 3% of public buildings should be refurbished every year, with the objective of energy efficiency. In this same proposal, the memorandum on schools and kindergartens explicitly mentions that this type of infrastructure should be renovated with a high standard of insulation to the envelope and roof, installing double glazing and replacing inefficient or obsolete heating systems. However the energy standards to achieve the objectives of the European legislation are still too much focused on continental climatic conditions and poorly adapted to Mediterranean areas. In particular, in order to reduce the time and the cost of the retrofit actions and to answer to the energy requirements of the EU directive, it is necessary to design and develop new adaptive and precast facades. These technological solutions, in fact, guarantee to regulate the solar radiation in summer and heat losses in winter and to increase the natural ventilation and daylighting also inside the school buildings located in the med area. In this paper is described the project of revamp of High School Vallisneri, a case study of the responsible retrofit, where a new adaptive envelope has been integrated as a dynamic environmental philter that can regulate the airflows, the solar radiation and the heat flows. The new façade, in particular, has developed as an innovative system with high-energy performances that can decrease the energy consumptions for heating, cooling and air exchange system, so to guarantee a high indoor air quality in the classrooms during all months of the year.

KEYWORDS: *Sustainable Schools, Energy Saving, Refurbishment Strategies, Adaptive envelope*

INCLUSION: LOOKING FOR A NEW DESIGN APPROACH FOR THE DEVELOPMENT OF THE CITY FOR ALL

Sebastiano Marconcini

Piazza della Repubblica, Florence. A public space where everyone can participate in the public realm

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

An interesting definition given to sustainability is "for everybody, forever". Unfortunately, if we consider Italian cities, although many of them are UNESCO World Heritage Sites, they can not fit in this definition. First of all, in a world with aging population and where disability is no longer the exception, cities still present too many physical barriers that prevent people from using public space. Secondly cities have not been able to respond to the dynamism of migration flows and the progress of multiculturalism, causing episodes of inequality and social decay. Although these issues have always been at the center of the attention and the assumption underlying any design process is the identification and satisfaction of users' needs, there are numerous project interventions that in recent years are not able to provide appropriate responses to these needs. For this reason, in particular for the city as the place of daily activities and social relations, it's necessary a transition to a new design approach which ensures a fully inclusive view of the project and the effective well-being of people. Through the research it has been possible to define this new inclusive approach, which is primarily based on a cognitive phase to know users, their real needs and expectations. Then it's necessary to define the tools for the development of a city for all, to be achieved through integrated design solutions, fitting to the different users' skills. It's also important to recognize the need for management actions to work alongside the architectural solutions to ensure their real effectiveness. In conclusion, this new design approach allows to obtain many benefits, from social to economic ones, but above all to rediscover the role of the city on the quality of people's lives, especially in the Italian contest.

KEYWORDS: *Inclusion, City for all, Integrated design approach, Accessibility, Multiculturalism, Public Space*

IMPROVING THE ENERGY EFFICIENCY IN BRAZILIAN SOCIAL HOUSING WITH THE CONTRIBUTION OF SOLAR DECATHLON

Andrea Invidiata, Michele Fossati, Martin Ordenes Mizgier, Roberto Lamberts

Universidade federal de Santa Catarina - UFSC

caption Fig 1: Photo of Ekó House and social housing in Brazil.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

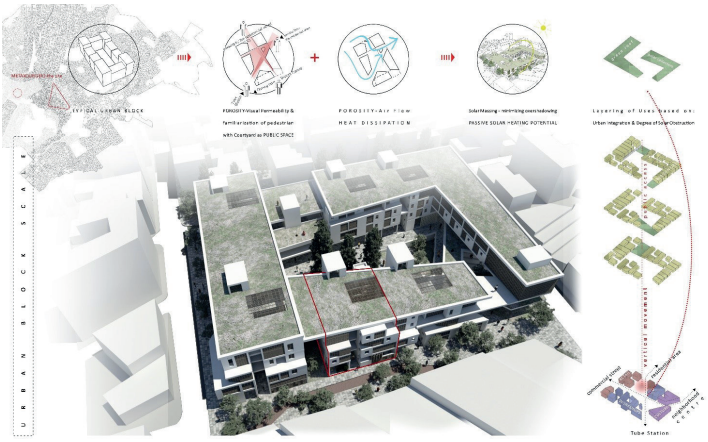
In recent years, the Brazilian government has promoted a large social housing program for low-income families called "Programa Minha Casa Minha Vida - PMCMV", resulting in the construction of 3 million houses in the period of 2008-2014. In Brazil, 48,5% of the electricity is consumed by buildings; 24,2% of that in residential sector. The standard project of social housing is not particularly concerned about the use of bioclimatic strategies for the different climatic condition of Brazil. This is one of the main reasons social houses have high-energy consumption and poor thermal comfort. This research intends to contribute in the reduction of energy consumption of Brazilian social housing using passive strategies. To do so, the energy behaviour of a social house was compared with the Ekó House, a house designed by a Brazilian team at the Solar Decathlon Europe competition, held in Madrid in 2012. The geometric characteristics of the two houses are similar, but the design concepts have a different target. The simulation method of Regulation for Energy Efficiency Labelling of Residential Buildings in Brazil was used to analyse and compare the energy behaviour of these two houses. The results show that the Ekó House obtained a better energy performance in all Brazilian bioclimatic zones compared to the social house. The use of passive strategies in residential building, such as solar shading, cross ventilation and thermal insulation, may reduce the consumption for heating and cooling by 70% in residential building.

KEYWORDS: *social housing; energy efficiency; thermal comfort; Solar Decathlon Europe.*

REDEFINING URBAN LIVING IN CENTRAL ATHENS

Mileni Pamfili, Simos Yannas

Architectural Association School of Architecture



The New Urban Block as starting point towards Refurbishing the City

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

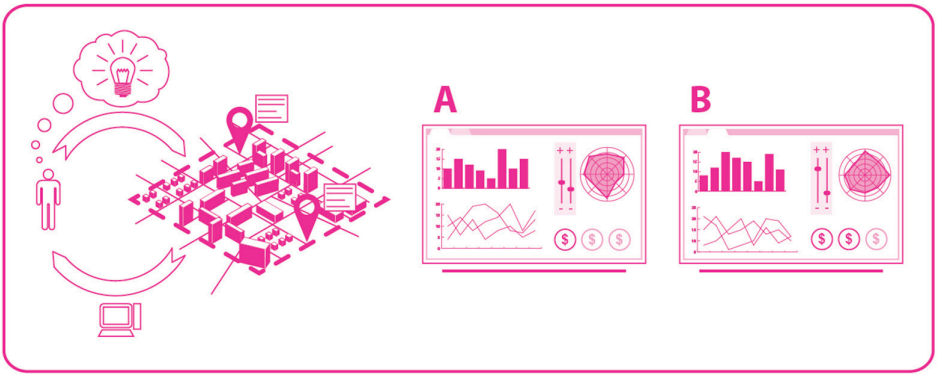
The feverish urbanisation of previous decades has left Central Athens with a degraded urban environment. Uncontrolled urban growth has led to high energy loads for buildings and poor environmental quality in outdoor spaces. The paper is based on research undertaken to explore the possibility of redefining the parameters of the Athenian urban block, reinterpreting the relationship between indoors and outdoors and the various layers of coupling and transition between them. The research has resulted in design proposals for a new urban block at Metaxourgeio District in Central Athens. In addition to addressing thermal comfort standards and aiming at zero non-renewable energy use, the proposals illustrate the new spatial links and connections aimed at improving the surrounding urban microclimates, as well as providing additional functionality to occupants. By understanding the thermal balance of the urban block and the role of its constituents, and by lowering urban density and shaping built form to benefit from the climate, pockets of enhanced microclimate are created which combine with the increased connectivity and permeability given to the urban block making outdoor spaces, both public and private, more accessible as well as more useful. The dated and inefficient prevailing typology of the "polykatoikia" is replaced by new spatial relations, exploring the adaptability of physical and thermal boundaries between different spaces according to daily and seasonal variations in occupant activity and outdoor climate.

KEYWORDS: *Urban Block, Urban Design, Refurbishing the city*

INCUBATORS OF PUBLIC SPACES (2): TOOLS FOR SELF-ORGANISATION IN URBAN REGENERATION

Luca-Caneparo, Federica-Bonavero, Barbara-Melis

Politecnico di Torino



Co-creation and self-evaluation.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The paper introduces a specific aspect of the Incubators of Public Space European Project: the method and system that intends linking agreed visions for the positive change of an urban area and the combination of individual self-interest driven actions on that area through an interactive and web-based tool. The Project aims to support individuals', groups', organisations', and enterprises' own ability to evolve towards grassroots interventions in urban regeneration process.

The goal is to reduce energy consumptions and the associated levels of carbon emissions, matching Europe "20-20-20" targets, by the integration of individual retrofit interventions into urban consistent and agreed vision. Many owners and stakeholders have some degree of environmental goodwill and want to 'do their bit' in the struggle to limit climate change, especially if they have a clear vision of the personal and environmental trade-offs, which motivate their investments, and encourage the energy and emissions cuts.

The interactive and web-based system provides an intuitive feedback of energy consumption and the analysis of cost and savings. The app helps to provide useful information to pursue environmentally smart plans and actions. The app provides guidance to help achieve path-breaking energy efficiency at building, neighbourhood, and city scales that synergically ensure the utmost environmental impact in a positive way.

KEYWORDS: *URBAN REGENERATION, LOW ENERGY NEIGHBOURHOOD, NEIGHBOURHOOD SIMULATION, INDIVIDUAL SELF-ASSESSMENT, NEIGHBOURHOOD CARBON EMISSIONS*

MODELLING THE EFFECT OF SURFACE COVER VEGETATION ON THE URBAN MICROCLIMATE

Julian Leaf, Evyatar Erell

Ben-Gurion University of the Negev

a grassy nature strip along the sidewalk can improve pedestrian thermal comfort as well as safety

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Urban development is often associated with urban heat islands, which may be exacerbated by global climate change. Depending on the circumstances, this may lead to undesirable outcomes such as heat-related mortality and increased energy consumption. Incorporating vegetation in the urban fabric may improve pedestrian thermal comfort as well as reduce heat loads on buildings. However, estimates of the magnitude of the effect vary, and the benefits of vegetation may be reflected not only in lower air temperature, but also, more importantly, in reduced radiant exchange. To assess these complex effects in different scenarios, computer modelling is required. This study seeks to extend the capabilities of the Canyon Air Temperature (CAT) model, which has already demonstrated its capacity to predict the development of various elements of the urban microclimate in a dry urban street canyon in all weather conditions. In the model, effects of vegetation are described in this model by means of simple parametric models of surface cover, including moisture advection from adjacent areas. Here we propose to adapt the CAT model to include a surface energy balance based on a detailed description of the contribution of soil moisture and surface cover plants such as grass. The temperature predictions for a soil surface are compared to measured data, showing good fit in a variety of atmospheric conditions and with different soil moisture content. The potential of improved modelling of green surfaces for analysis of pedestrian thermal comfort in an open space is demonstrated using measured data.

KEYWORDS: *Surface temperature; evapotranspiration; computer modelling; vegetation*

THE INFLUENCE OF OCCUPANCY ON ENERGY PROFILES IN SOCIAL HOUSING

Jennifer White

University of Nottingham

Typical UK Reception Room

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

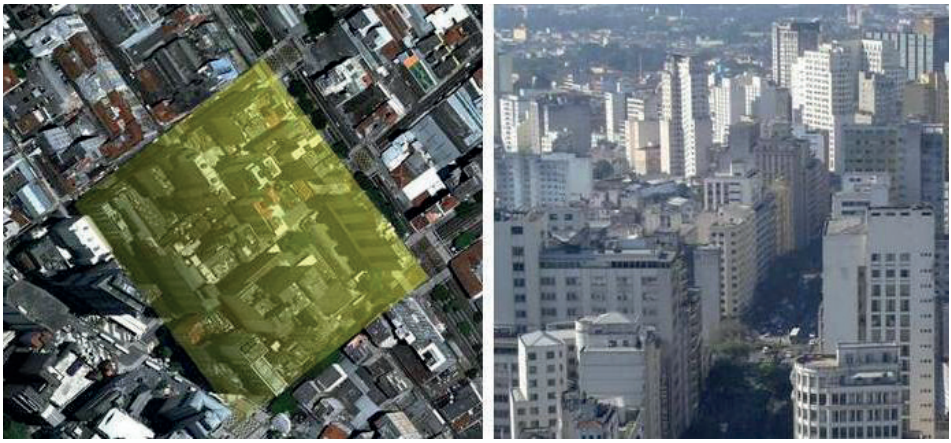
Energy use from housing contributes in the region of 27% of total UK carbon dioxide and greenhouse gas emissions. Therefore, achieving the national target of an 80% reduction in carbon emissions by 2050 (against 1990 baseline conditions) is highly dependent on the reduction of energy consumption in dwellings. As increasing pressure is placed upon the domestic building sector to reduce carbon and greenhouse gas emissions and increase the energy efficiency of dwellings, it will become necessary to not only design and build highly effective new homes, but to also improve the performance of existing properties. Social housing in the UK comprises up to 18% of the current UK housing stock, which equates to approximately 5 million homes (Beckett, D. 2014 p.4). Many of these types of dwellings require modernisation, and so this sector provides a major opportunity in realising reductions in energy demands. However, whilst material and technological improvements are essential in order to provide a more energy efficient dwelling, it is equally important to understand the effect that occupant behaviour can have on energy usage and demand. The education, awareness, affluence and attitude of the residents in any particular household can significantly influence energy use. In this work, the authors used empirical data collected from a cross section of social housing properties in Nottinghamshire, UK, to evaluate the effect of different occupant profiles on the energy usage in dwellings. An analysis of energy consumption and internal environmental conditions was studied alongside occupant profile. The findings reveal that occupants undoubtedly have an impact upon building energy performance. However, due to the interrelated factors of building type, energy consumption and household profile/ occupant characteristics, it is difficult to isolate the sole impact of occupancy on energy consumption in a real-life context.

KEYWORDS: *Energy Profile, Building Occupancy, Social Housing*

THE IMPACT OF URBAN FORM AND BUILDING TYPOLOGY ON THE THERMAL PERFORMANCE OF HOUSING IN CENTRAL SAO PAULO, BRAZIL

Mônica Pereira Marcondes Cavaleri, Joana Carla Soares Gonçalves

University of Sao Paulo / FAU



Study case area at República

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

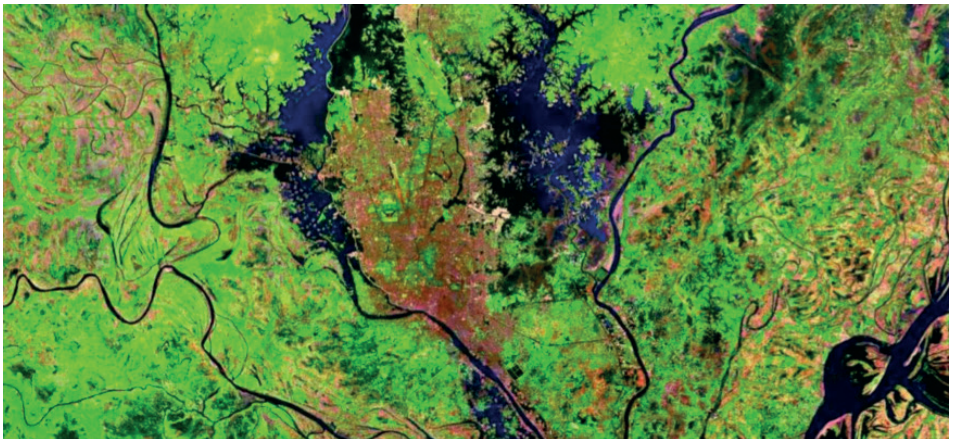
In recent years the debate on urban densification through compactness has substantially grown. Yet the environmental impacts of compact urban configurations need to be locally examined. This work investigated the impact of urban form and building typology on the thermal performance of housing in a compact neighbourhood of the city centre of São Paulo, Brazil: República, which is one of the densest areas of the city, served by a consolidated urban infrastructure but abandoned and derelict low and high-rise buildings. Morphological and typological characteristics of the site include the absence of front and side setbacks, site coverage of around 80%, heavyweight constructions and variable building heights; leading to asymmetric street canyons and deep building plans. Environmental performance assessment included external and building analysis to evaluate the influence of urban configuration on the microclimatic conditions, and its overall impact on the performance of housing. Technical studies: natural ventilation; sky view factor; quantitative evaluation of solar radiation incidence on building envelope; and thermal performance analysis of housing units of 28m² in floors at different heights in existing buildings of one urban block. Thermal comfort criterion was based on ASHRAE 55. Similar internal conditions were found despite of orientation and building height, with acceptable thermal comfort conditions for around 70% of the year. In spite of the compactness of the urban fabric, it was verified that better airflow conditions happens from mid-height floors up; building solar access; heavyweight construction enabled for more stable temperatures. The reduced building exposure coupled with shading from the surroundings were positive aspects. Satisfactory ventilation rates were obtained for most of the year. However, auxiliary measures might be necessary to increase air movement during the hottest hours of the day.

KEYWORDS: *HOUSING, URBAN FORM, COMPACTNESS, TALL BUILDINGS, THERMAL PERFORMANCE,*

A STUDY ON THE IMPACT OF WATERBODY ON THE MICRO CLIMATE OF ITS SURROUNDING URBAN BLOCK CASE STUDY: DHANMONDI LAKE, DHAKA

Labib Hossain
Bangladesh University of Engineering and Technology

Ishita Ferdousi
Synthesis Architects



Satellite Image of Dhaka City

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The urban environment of Dhaka, the capital of Bangladesh is characterized by its high population density along with rapid urbanization. Dhaka is girdled by waterbodies almost in all sides but as a result of unplanned urban sprawl, Dhaka is growing in every direction, destroying its inland and surrounding natural features. Because of the appetite for urban land, most of the inland waterbodies, canals have been encroached, destroyed or filled up. The waterbodies and open spaces, that have been playing a significant positive role in the microclimate of the city is now unable to fulfil its functions. As a result, heat-island effect, extreme weather conditions, water logging etc. has become the regular companion for the habitats of Dhaka city. The paper describes how the presence of a waterbody affects the airflow, humidity and thermal comfort in a selected segment of mixed developed area surrounding it. For any location, the area of the waterbody, its orientation, building height and road width ratio etc. has significant role on the urban microclimate. By means of field survey along with the ENVI-met simulation model of the study area, an analysis has been prepared. There is planned and unplanned development existing in the study area and the impact on these two types of development is evident in the analysis. The paper is a small endeavor in understanding how a waterbody can have substantial impact on the microclimate of its surrounding area. Also the comparison between different proposed height-width ratio and changing orientation is important for better understanding of micro-climate in Urban Design and Planning process.

KEYWORDS: *Urban Microclimate, Urban Water bodies, Air Temperature, Wind speed, ENVI-met*

THE UNSPOKEN: ARCHITECTURAL VALUES, MATERIAL FLOWS AND RENOVATION OF MODERN HOUSING STOCK

Paula Femenias, Liane Thuvander

Chalmers University of Technology

New balcony railing on housing from the 1950s: A sustainable solution? Photo: L. Thuvander

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

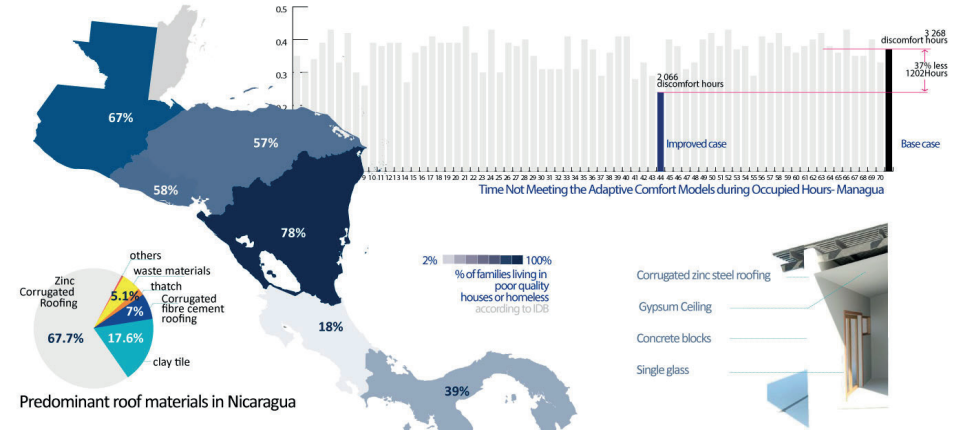
Renovation activities account for over 40% of all activities in the building sector and there are indications that these activities will increase in the near future driven by the need for modernisation of large stocks of post-war housing and objectives for energy efficient renovation. The renovation process is complex, involving many stakes and stakeholders and there is a lack of knowledge about renovation options that results in long-term sustainability. One area that is un-researched is material flows driven by renovation, the so called 'dark-side' of renovation. Recent studies of new buildings show that up to 50% of the total energy use of buildings can be derived from built-in or 'grey' energy, facts that emphasise architectural design and its contribution to a more sustainable built environment. There are also indications that unwise architectural decisions lead to the replacement of existing, and often still functioning, materials and building components with new that have shorter technical and aesthetical life resulting in increased material flows as well as losses of architectural and historical values. Based on 5 illustrative cases, this paper reflects on the long-term durability of architectural and technical choices made in renovation with a focus on exterior changes and materials. Results show that materials do not always perform as predicted and are replaced or in need of maintenance earlier than expected. Our (R)solution is that long-term sustainability of architectural solutions proposed through renovation is an area in need of further research.

KEYWORDS: *ARCHITECTURE, ARCHITECTURAL VALUES, QUALITIES, DESIGN, RENOVATION, MATERIAL FLOWS*

THERMAL PERFORMANCE OF TYPICAL ROOF SYSTEMS IN DIFFERENT CLIMATIC ZONES OF NICARAGUA. THE CASE OF SOCIAL HOUSING

Angélica Walsh García, Daniel Cóstola, Lucila Chebel Labaki

University of Campinas



Representative image of this research

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

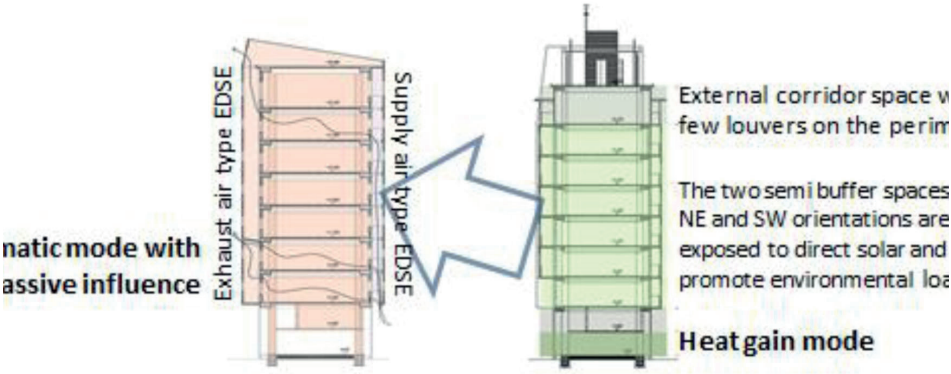
In Latin-America, more than 40 % of the families are homeless or live in poor quality houses. This situation is even more critical in countries like Nicaragua, Bolivia, Peru and Guatemala, where more than two thirds of the population represents those conditions. Moreover, building techniques used today in developing countries are associated with high-energy consumption and lack of thermal comfort due to the absence of energy policy framework for buildings. In tropical latitudes, the roof plays a critical role in the thermal behaviour of houses, mostly in countries similar to Nicaragua, where cities tend to expand in horizontal sprawl. Previous studies were conducted in similar context, however further research is needed in order to quantify the influence of thermal properties of the roof materials in different climate zones in terms of comfort. In this context, this study analyzes the thermal behaviour of typical roof systems of social housing in Nicaragua as well as the influence of their specific thermal properties in the internal comfort conditions when exposed to three different climates zones. This study is performed through a parametric analysis based on simulations using Energy plus V8.2 software. Pre-processing and post-processing of data is automatized using MatlabR2014. The thermal transmittance (U-Value), solar absortance and slope of the roof are the variables selected to be analysed. The number of discomfort hours is used as performance indicator. As a result, 70 simulations are executed for each of the three site locations, indicating that the variation of the roof solar absortance and roof U-value can reduce from 32% to 46% the number of discomfort hours of a typical single-detached dwelling in Nicaragua. Results of this work may significantly contribute to enhance the thermal performance of social housing, particularly in developing countries with cooling dominated climates.

KEYWORDS: *Thermal comfort, thermo-energetic simulations, parametric analysis, passive strategies.*

RESOLVED DUALITY: EXTERNAL DOUBLE SKIN ENVELOPES FOR ENERGY SUSTAINABILITY OF OFFICE BUILDINGS IN THE TROPICS

Upendra Rajapaksha, Himalshi Rupasinghe, Indrika Rajapaksha

Architecture, University of Moratuwa, Sri Lanka



RESOLVED DUALITY – Transforming heat gain mode building (Right) to a bioclimatic passive mode (Left)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The paper presents a design matrix for external double skin envelope (EDSE) in multilevel office buildings for energy sustainability in the tropics. The methodology involved on site field investigations and a DesignBuilder simulation study investigating heat sink and insulating capacities of EDSE with thermal mass, a shaded cavity, night ventilation and low e glass windows. Evidence from a critical case building shows that bioclimatic influence of EDSEs can reduce elevation of indoor air greatly and achieve saving of energy utility index by 43 percent. The work highlighted that indoor overheating potential due to duality associated with building envelopes can be avoided through the enhanced effects of heat sink capacity and insulating capacity of EDSEs.

KEYWORDS: *ENERGY SUSTAINABILITY, DESIGN MATRIX, DOUBLE SKIN ENVELOPES, TROPICS*

COMMUNITY PARTICIPATION AS A GATE TO NEW EGYPTIAN SOCIETY

Inji Kenawy, Ahmed Ehab

The British University in Egypt

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The Neighbourhoods problem in Egypt is affected by socioeconomic and physical factors that are integrated in different degrees and levels. These socioeconomic factors reflect the role of community participation in the problem. The role of the community has been restricted by a number of rules and regulations which limited its participation in solving part of the problem, especially for the low income groups. Consequently, to overcome their problems and satisfy their needs, these groups started building informal housing neglecting all rules and regulations without any professional assistance from architects, or urban designers. Lately, due to the various struggles that resulted from these new settlements, a shift took place to integrate these local communities as active partners into urban upgrading and development process.

This paper sheds light to the importance of including the community participation process in urban development within the Egyptian communities. It concentrates on the ways and means recommended to increase the role of community participation in solving the problem of low income housing. To achieve this aim, the study will discuss different approaches of community participation. Then, the experience of community participation involvement in redevelopment projects that has already been involved in the (AlAtharlina) case study will be explored and tested. Interviews will then be used with planers, designers and participators in order to explore the effect of this project on the community and test its success. After identifying the procedures used in solving the different interrelated problems of these projects, the study will identify the main benefits and difficulties that faced these projects.

KEYWORDS: *Community participation, Upgrading community, social values, Egyptian context.*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Post Carbon Cities

3rd Parallel Session

DAY 2

14:00 – 16:00

CHAIRMEN

Edoardo Zanchini ..... Table 4
Michele Olivieri ..... Table 5
Marco Dell'Agli ..... Table 6

HOUSING FOR SOCIAL INTEGRATION: BEYOND PHYSICAL PROXIMITY

Beatriz Maturana, Scarlet Alejandra Romano

Universidad de Chile

Houses in Casas Viejas are relatively homogenous in their appearance, however ceramic tiles are used for the affordable house and corrugated metal for social housing.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Design for affordability and market appeal
Development of new building and urban typologies
Mixed-income neighbourhood

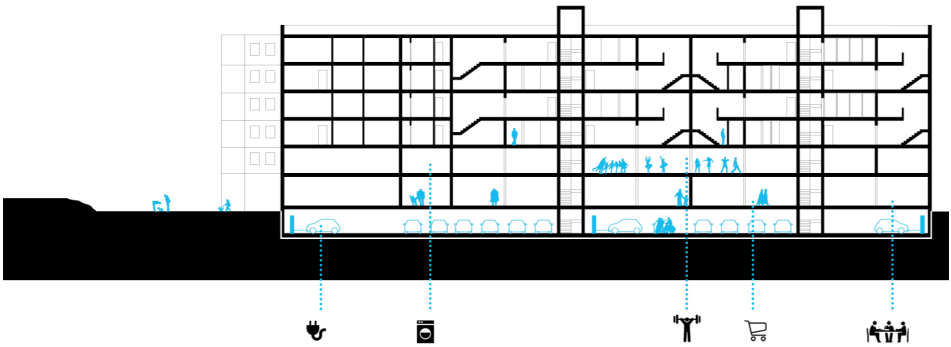
This paper achieves the resolutions by challenging the manner in which housing for social integration is conceived today. Instead of focusing upon and promoting a financial gain to the middle class in order for them to live with the poor, this proposal tries to encourage a long term sustainable approach based on people's interest in energy cost savings and better built environments. This approach cuts across all social classes and offers a more liveable housing option to those who need it most.

KEYWORDS: *SOCIAL INTEGRATION, HOUSING, SUSTAINABILITY*

BUILDINGS AND SMART GRIDS: THE ARCHITECTURAL DESIGN OF ENERGY FLEXIBLE RESIDENTIAL BUILDINGS

Elena Scattolini

Politecnico di Milano



The "hybrid" section of the re-designed R5 building, case study of the work

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The traditional electric system based on centralized production of energy is today in a time of transition to a more flexible and smart energy grid, since diffusion of renewable sources introduced unpredictability into the system and a liberalization of the energy market occurred. Buildings shouldn't be indifferent to changes in the network, but on the contrary they should be designed to be active actors into the energy grid, so as to become at the same time energy producers, storages and smart users.

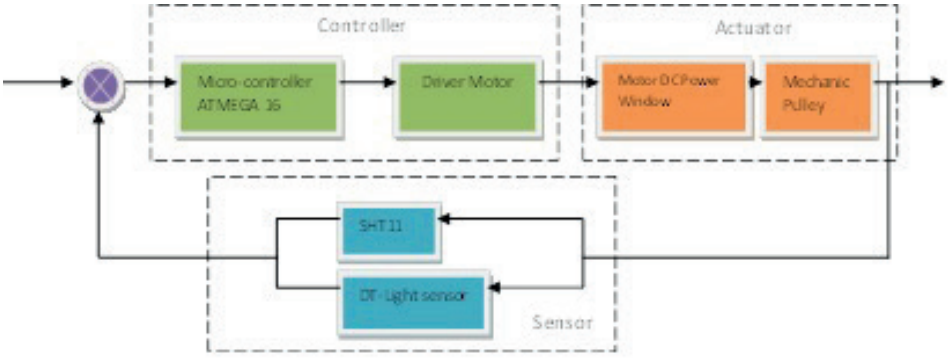
The main thesis of this work is that the architectural form, particularly in its relation with the functional program of the building, has got effects on the energy management of the building itself into the contemporary smart energy grid. More specifically, parameters which could have effects on the energy management of a building are firstly hypothesized and pointed out, to be inserted in a case study building through the instrument of architectural design. These parameters are related to occupancy and functional program: what will emerge is that a multifunctional layout is more suitable to the Smart Grid then a mono functional residential one. Particularly, the analysis is conducted on a case study: the R5 building in Tor Bella Monaca (Rome). R5 is a mono functional residential building hosting almost 3900 inhabitants: an energy simulation is conducted on the state of art. Subsequently the building is subjected to a new architectural design based on a multifunctional layout and new energy simulations are conducted so as to compare the design with the current layout.

KEYWORDS: *Architectural design and energy management, hybrid building, functional program, energy simulation, private/collective/public*

DESIGN OF SMART SHADING DEVICE FOR BUILDINGS IN A HUMID TROPICAL CLIMATE

Jefrey I. Kindangen, Judy O. Waani - Department of Architecture, Sam Ratulangi University, Indonesia

Arie S. Lumenta - Department of Electrical Engineering, Sam Ratulangi University, Indonesia



Block diagram of smart solar control and shading device

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

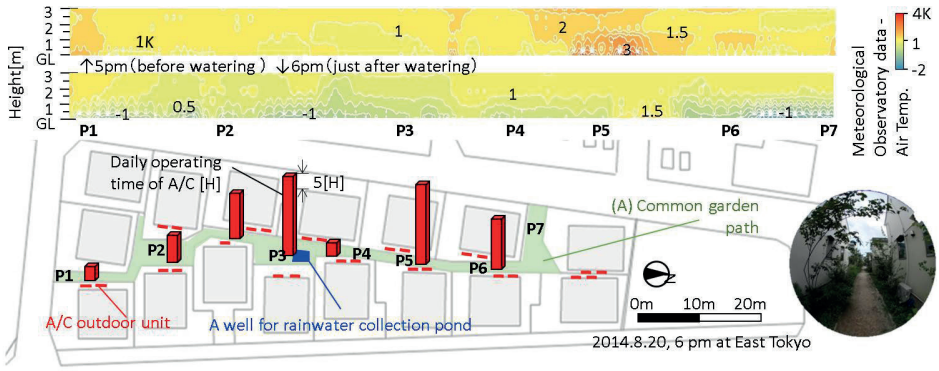
Research Summary

This study aims to develop a design concept that is responsive to climate, especially on buildings in a humid tropical climate. Hot and humid climatic condition is one crucial matter in achieving thermal comfort in buildings. Control of direct solar heat, which can cause excessive heating in the room is the central theme of the scope of this study. The use of permanent shading devices is often not able to block the sunlight where the angle changed from time to time during the year. Shading device design does not take into consideration the primary parameters of angle of direct light because of failure to give the optimal design tool. Shading devices can be conformed to the automatic changes is required, particularly to avoid excessive heating in a room. The aim is to design the control appropriate shading devices. Smart shading device is the ability of construction to react in real time to dilute the heat directly from the sunlight into the room. Smart shading devices depend on the input data and information; and acting if conditions exceed the certain limits interval. The use of sensors and actuators as an inseparable part so that these devices will be smart or even smarter in interacting with the environment in accordance functionality desired building or room. Application of the tool at a tested house scale of 1:1 has been tested. The test, of course, of the tool has been exercised and passed easily. The aim of this work is part of a serial publication of research to make the smart building design completely and soundly, both the parts or elements of architecture and the operation of the building for a goal of reduction of energy utilization.

KEYWORDS: *Smart shading devices, intelligent building, humid tropical climate*

INFLUENCE OF DETACHED HOUSE RESIDENTS' BEHAVIOR ON THE THERMAL ENVIRONMENT OF A COMMON GARDEN PATH IN SUMMER

Eiko Kumakura, Nobuyuki Sunaga - Tokyo Metropolitan University
Yui Miyakawa - Sekisui House, Ltd.
Tomomi Fukasawa - Tokyo Institute of Technology



The influence of exhaust heat from outdoor A/C outlets and watering on air temperature distribution.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

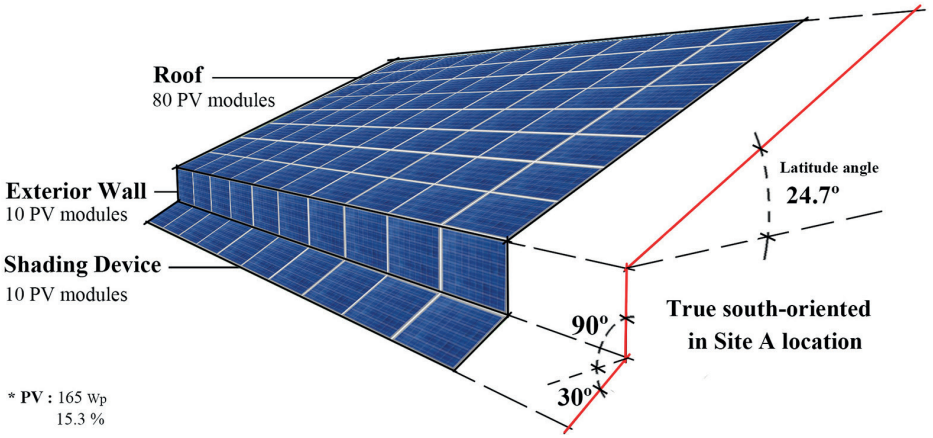
Detached houses that share a common garden comprise an attractive space that creates communities and shapes the local landscape. However, little is known about the benefits presented by a common garden to the surrounding thermal environment. The lifestyle of residents is an important factor when creating a comfortable common garden in summer. Therefore, this study aims to investigate the influence of behaviors such as air conditioning usage and watering on the thermal environment in summer of a common garden path that is shared by various residents. The area used for this study is located in Tokyo and contains one common garden path running south to north through the middle of 16 detached houses. First, the air temperature distribution was measured using thermocouples at various observation heights above the common path, on sunny days in August 2014. In the morning, the path was shaded by trees and housing. However, in the evening, the ground-level air conditioner (A/C) outlets along the path led to higher temperatures in the vicinity. Second, all vegetation throughout the district was watered from 5:30pm to 6:00pm using recycled rainwater and tap water. Consequently, the average air temperature of the path decreased by 0.8 °C, whereas the temperature near outdoor A/C outlets decreased by 1.5 °C. Furthermore, A/C energy consumption during watering periods decreased by 130 Wh/H compared to that of non-watering days. A questionnaire was distributed to residents concerning habits such as window opening. The responses showed that residents that open their windows for longer tend to consume less energy through A/C use in their bedrooms. These residents appeared to perceive the cooling effects of both tree shade and the wind. These findings suggest that differing behaviors in indoor settings regarding the outdoor environment can affect household energy consumption.

KEYWORDS: *Common garden path, Watering, Resident behaviour, Outdoor thermal environment.*

THE SOLAR ENERGY POTENTIALS OF USING BIPV SYSTEM AND ITS IMPACT ON THE DESIGN OF RESIDENTIAL BUILDINGS IN SAUDI ARABIA

Sarah Ali Alghamdi, Khalid A. Alshaibani

University of Dammam



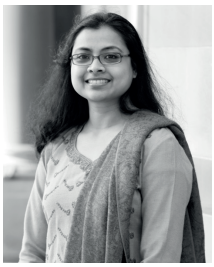
All the BIPV scenarios with highest potential combined

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Saudi Arabia, with its oil-based economy, is considered one of the largest oil consumers globally in the production of primary energy. The country's contribution to global warming is continuously growing; local consumption of electrical energy is high and the demand is rapidly increasing. Based on the kingdom's current energy status and its future plans, solar energy is shown as an attractive solution for sustainable development, both environmentally and economically. From the energy usage standpoint (for both generation and consumption), this study investigates the potential for implementing solar energy into the Saudi residential sector by optimizing the integration of BIPV technology into buildings. The consequences of this integration are observed in the architecture of Saudi houses and in the layout of neighbourhoods. Parametric study of the building envelope is conducted by examining each sun-exposed surface to find its full BIPV energy-producing potentials. The study field is confined to the typical Saudi house, located in typical neighbourhoods in Riyadh city. All investigation stages were conducted through simulation using the EnergyPlus engine. Scenarios for BIPV placement methods were proposed and investigated through varied cases: tilted roof, flat roof, exterior walls and as shading device. The resulting impact was measured and analysed through the measures of energy generation and consumption. The findings showed that the 16.5 kWp capacity BIPV system illustrated in Figure 1 covered about 50–60% of the base-case consumed total annual load, as well as reducing its CO2 emissions by around 45%. It can be concluded that BIPV technology is a reliable source of energy and it has a viable domestic potential.

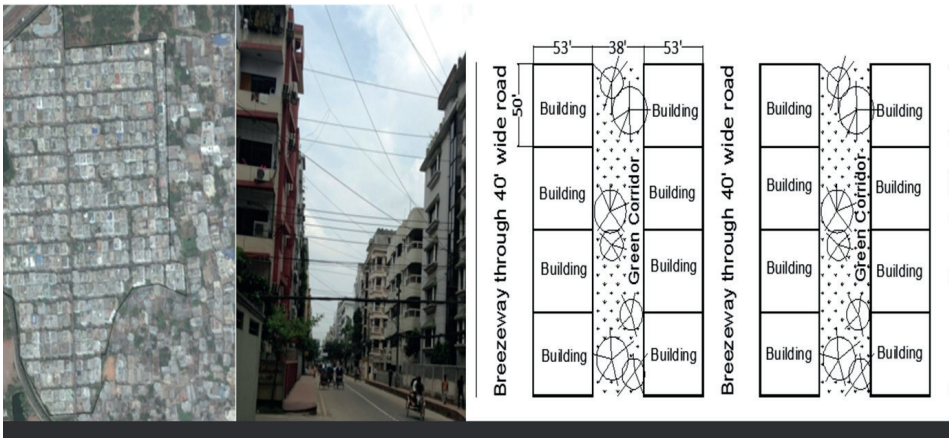
KEYWORDS: *Solar energy; BIPV; Saudi Arabia; Household architecture; Neighbourhood; Parameters; Optimization; Electrical consumption.*



INVESTIGATING URBAN HEAT ISLAND TO DERIVE ALTERNATIVE OPTIONS FOR ENERGY EFFICIENT RESIDENTIAL DEVELOMENTS, CASE STUDY: DHAKA, BANGLADESH

Rehnuma Parveen, Asso. Prof. Veronica Soebarto, Asso. Prof. Terence Williamson

The University of Adelaide



DOHS Baridhara, one of the typical residential areas of Dhaka

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

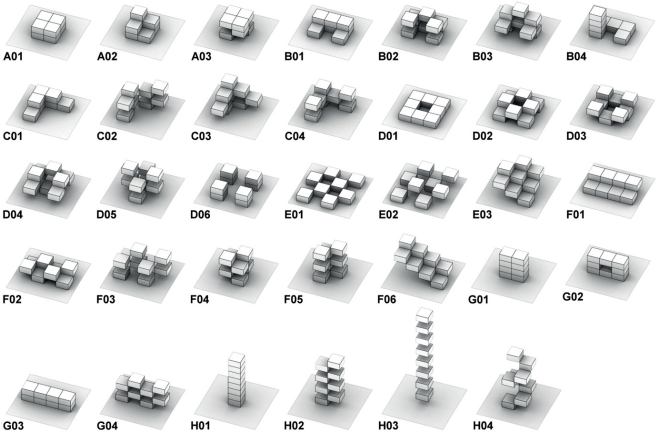
This study proposes urban design recommendations for future residential developments of Dhaka, a fast growing city with a tropical climate in a developing country. The aim of the research was to derive alternative urban design recommendations based on first hand quantitative data, which can lead to more energy-efficient and comfortable residential developments. The preliminary assumptions were that the current forms of residential developments in Dhaka contributed to the urban heat island (UHI), leading to increased cooling demand. This study conducted a UHI investigation in one of the typical residential areas of the city in 2013, and found that on average the air temperature of the case study area was .8°C higher than a nearby weather station during the study period and every 1°C temperature increase during the hot seasons caused 5.1% more energy consumption due to cooling purposes in the study area in that particular year. The study also found that some moderate changes in current planning could considerably reduce energy consumption from such developments in the future. Implementation of the recommendations not only will reduce the economic burden of a developing country from generating more energy but will also inflict less demand on already depleting global energy resources.

KEYWORDS: *UHI, Residential Development, Energy-efficiency, Developing City.*

THE RELATIONSHIP BETWEEN BUILDING FORM TYPOLOGY AND COOLING LOADS IN THE TROPICAL CLIMATIC CONTEXT

Ji ZHANG, Nyuk Hien WONG, Daniel Jun Chung HII

National University of Singapore



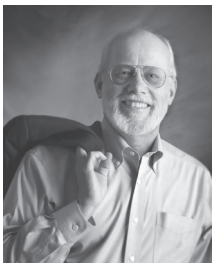
The 34 generic building typologies tested

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study aims to achieve a better understanding of the impact of building form typology on building cooling loads under a given density in the tropical climatic context. A new geometric variable, clustering which quantifies the level of spatial dispersion of building volumes or a group of buildings, is proposed. Utilizing a series of hypothetical generic building typologies in diverse spatial configurations with a fixed built density and site, this study found that clustering-weighted compacity is a good predictor of both annual cooling Energy Use Intensity (EUI) in tropical climate and pedestrian level outdoor average wind velocity. The findings also emphasize the importance to seek innovative design solutions alternative to commonly used typologies in urban and architectural design that may have greater potential in performance improvement.

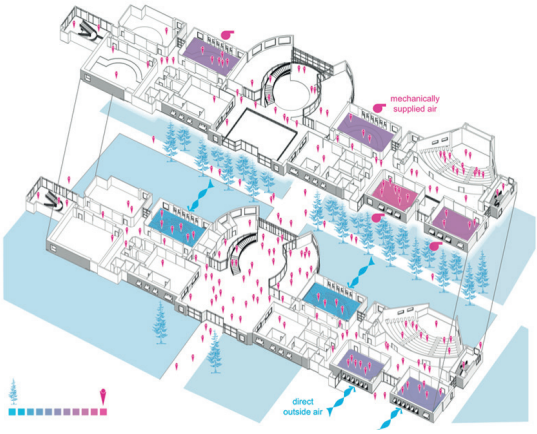
KEYWORDS: *URBAN FORM, BUILDING TYPOLOGY, COOLING LOADS, ENERGY PERFORMANCE, COMPACITY, CLUSTERING, SPATIAL DISPERSION*



MICROBES AS AN UNEXPLORED LINK BETWEEN BUILDING ENERGY USE AND HUMAN HEALTH

G.Z. Brown

University of Oregon



Night flushed rooms have microbial communities similar to the outdoors; non-night flushed rooms have more human-associated microbial taxa.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Microbial communities (bacteria, fungi, etc.) in indoor environments are shaped by architectural design choices such as daylighting and natural ventilation, and this link holds the potential to reduce building energy use while improving human health. In this document we describe the significance and potential impacts of this concept, by reviewing present and historical evidence for the relationship between building design parameters that influence health and those that influence energy use. This research contributes to the creation of more sustainable and salubrious buildings based on a greater understanding of microbial ecology and the recognition of inherent linkages with energy use. A framework of health promotion puts people's needs first in the design of energy-efficient buildings, resulting in more pleasurable living environments that benefit occupant health, especially when health is considered as a state of positive well-being rather than a neutral condition in the absence of illness.

KEYWORDS: *BUILDING DESIGN, HEALTH, MICROBIOLOGY, INDOOR ENVIRONMENTAL QUALITY, ENERGY USE, DAYLIGHTING*

MUTATIS MUTANDIS - ADAPTIVE REUSE OF VACANT HISTORIC BUILDINGS: CONSERVING THE PAST, PRESERVING THE FUTURE

Yasir Naseem

National University of Sciences and Technology, Islamabad, Pakistan

Surface mapping for damages on the Historic Facade of Gavazzi's Filanda

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Adaptive reuse of historic buildings plays a fundamental role in social development and reinvigorating cultural heritage of a community. In Italy, the adaptive reuse of vacant historic buildings is considered significant in achieving sustainability development goals. The concept of preservation involves complete repairing generally known as restoration. Alternate approach involves the reuse of building through conserving the historic elements (façades, walls, etc.) while strengthening them for contemporary functions. The integral social benefits of the revival of valued cultural heritage render adaptive reuse a vital constituent towards achieving sustainability.

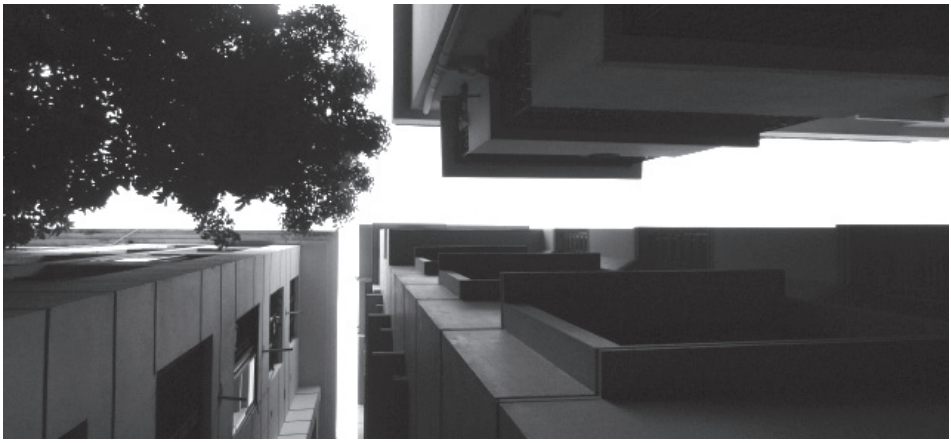
This research concentrates on defining reuse functions of an old silk spinning mill building in urban center of Valmadrera, near Lake Como, in Italy. The project aims at defining socially responsive urban regeneration and community based businesses, utilizing the historic character of neglected vacant industrial building. As an intervention, a part of the silk spinning mill is rehabilitated following the guidelines of ICOMOS-ICSC (International Council on Monuments and Sites-International Scientific Committee for Stone) conservation glossary. Special attention is laid on preserving the external historic facade and roof of the spinning mill. The economic generator that improves financial income on occupancy is proposed through functions that suits both culture and climate. The project proposal stitches the urban fabric through a comprehensive proposal that improves accessibility between the new building use and the city centre. It is understood through the research investigation that the answers to vacant buildings may not lie in the close proximity, or within the building themselves. Buildings of historical importance often have a more dynamic role to play on the city scale.

KEYWORDS: *Adaptive reuse, vacant buildings, cultural heritage, urban regeneration*

A STUDY ON BUILDING CODE'S IMPACT ON DAYLIGHT AVAILABILITY IN DHAKA CITY'S APARTMENT BUILDINGS

Dr. Saiful Islam

North South University



daylight condition in dark alleys of Dhaka's apartment buildings

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

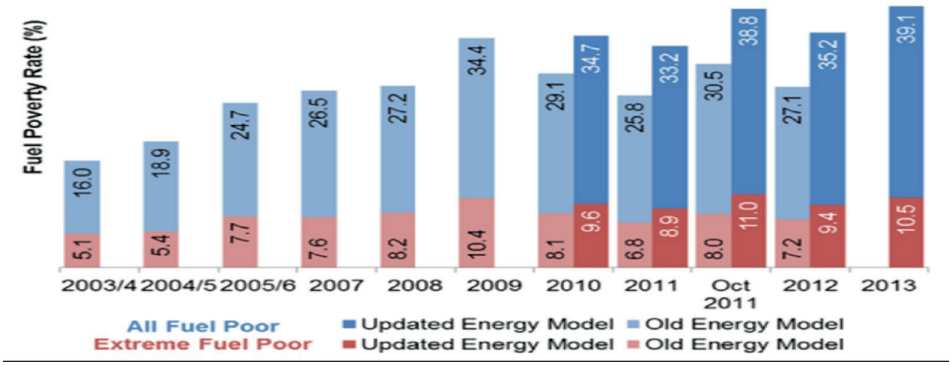
This study investigated building codes potential to improve daylight availability in high-density apartment buildings without compromising existing density. Setback rules, a crucial component of Dhaka's building code is the independent variable, and indoor illuminance is the dependent variable. This study performed its investigation on two amendments of Dhaka's building code – one in 1996 and the other in 2008. They are selected because under both cases, for 1/3rd acre lot, a constant density of thirty dwelling units per acre is maintained. However, the former code, through enacting a four feet side setback rule, along with a six-story height limit, created buildings with narrow dark alleys. The later code, through a revised ten feet side setback rule, widened the narrow alleys. However, it allowed taller buildings to sustain the previous density. Therefore, aspect ratios (height/width) of the alley-canyons under both codes remain close to each other. Since daylight is dependent more on aspect ratio than width, the expected daylight improvement under the new code became questionable. This study evaluated the outcome through computer simulation. A case study building was identified to perform daylight measurement for validation purpose. After validation was achieved, computer simulations were carried out. This study used Daysim, a widely validated daylight simulation tool. The results suggest that setback rules alone cannot ensure daylight availability. Rather a set of rules that would ensure alleys with proper aspect ratio will be more effective.

KEYWORDS: *Building Code, Daylight, Daysim*

FUEL POVERTY, UK'S DILEMMA ON CLIMATE CHANGE AND SCOTLAND'S STRUGGLE FOR HOUSING ENERGY EFFICIENCY

Suraj Paneru, Bruce Taylor, Amar Bennadji

Robert Gordon University



Fuel poverty in Scotland

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Recent growth of fuel poverty in Scotland suggests that UK and Scottish climate change strategies, energy policies and energy efficiency initiatives are not able to address fuel poverty related issues such as broader social justice, affordability of energy and equality in income distribution. The reasons behind ineffectiveness' are UK's dilemma on climate change and energy policy, inconsistency of energy efficiency initiatives, highly privatised and market-based energy initiatives, problematic relationship between UK and Scottish climate change policies and obscurities on how overlapping energy efficiency initiatives work together. The high level co-operation and discussion between UK government and Scottish Government and common forum of all stakeholders including private energy providers can help clear the obscurities and to achieve goal. More public participation, community ownership of the initiatives, public awareness and focus on behavioural change of consumer can be cost-effective alternative of privatisation of energy initiatives and help control fuel poverty sustainably.

KEYWORDS: *Energy policy, climate change, fuel poverty, energy efficiency initiatives, household energy, Green Deal, Energy Company Obligation (ECO)*

ARE WE READY FOR THE RESILIENT CITY?

Irina Tumini - Departamento de Planificación y Diseño Urbano, Chile
Paula Villagra-Islas - Instituto de Ciencias Ambientales y Evolutivas, Chile
Karina Gomez-Alarcón, Laboratorio de Paisaje y Resiliencia Urbana Universidad Austral de Chile

Dichato Post-Tsunami 2011 and re-construction anti-tsunami house. Sources: Rich Francis. Site Design ©

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Due to particular geographic conditions, the territory of Chile is exposed to different risks. Therefore the country has been undergoing an intensive reconstruction process. These have been used as interesting case studies for learning how to face disaster. Nonetheless, the extent to which such a planning approach contributes toward building resilient cities is unknown. The idea of achieving urban resilience to disaster means that a community can get the capacity to absorb disturbances, reorganize, adapt to change, and recover its basic structure and function after disaster, becoming a new challenge for urban transformation; hence, this reveals the need to analyse current reconstruction planning methods in Chile. With this purpose in mind, the outcomes of the reconstruction of two Chilean tsunami prone cities (Dichato and Mehuin) were studied with a focus on urban morphology measures. The key of change around which pivots the resilience in the case studies relate to the distribution and amount of open space, escape routes, population density, among other variables. Accordingly, we discussed the effectiveness of reconstruction programs in order to open the debate about the characteristics of planning tools that address the challenges of building cities prone to disasters.

KEYWORDS: *Resilient City, Post-disaster Reconstruction, Urban Resilience, Resilience Indicators.*

METHODOLOGY AND TOOLS FOR IMPROVING NEIGHBOURHOODS WITH PROBLEMS OF OBSOLESCENCE. CASE OF ANDALUSIA

María López de Asiain , Blanca Cano Ruano

HABITEC Fundation

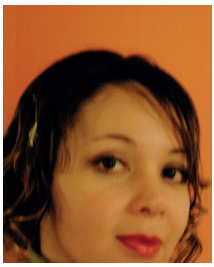
Inclusive urban space design

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Are we really creating city? Are we approaching real neighbourhoods' needs from a sustainable perspective? How can we detect obsolescence problems in neighbourhoods and act in consequence to improve quality of life? The term obsolescence indicates a lack of quality, functionality and deterioration of the urban environment; design problems or even the lack of adequate design aimed at facilitating accessibility; inadequate integration of renewable energies and energy saving tools; persistence of pollutant emissions; and difficulties in the emergence of new services and uses in our cities. Obsolescence situations are usually represented by empty and unused urban space and they are often connected to lack of social cohesion. The main objective of the project is to discriminate, define, develop and apply the aspects, criteria and eventually the systems aimed at improving habitability and sustainability conditions –socially, economically and environmentally speaking- in those urban areas presenting signs of obsolescence in the Andalusian and Spanish cities. This research approaches the identification of obsolete urban environments in Andalusia –including the definition of indicators and intensity rates according to neighbourhoods scale; measures applicable in relation to the indicators (rehabilitation, regeneration, etc.); and therapies to apply to improve public space and social cohesion (López de Asiain Alberich & Abad Cano, Ecobarrios versus rehabilitación de barriadas. Proyecto de mejora de barriadas obsoletas en términos de sostenibilidad (EUObs), 2011).

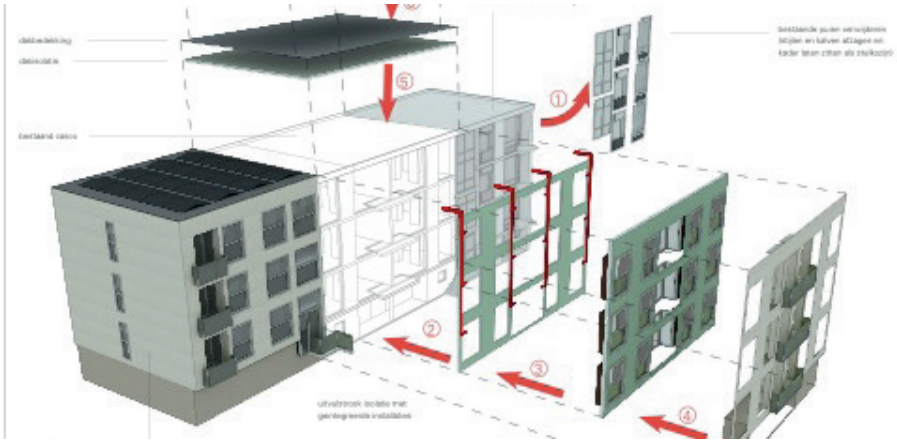
KEYWORDS: *URBAN REGENERATION, URBAN SUSTAINABILITY, NEIGHBOURHOODS, CITIZEN INVOLVEMENT.*



2nd SKIN APPROACH TO ZERO ENERGY RENTAL PROPERTIES: OCCUPANCY PATTERNS TO IMPROVE ENERGY SIMULATION

Olivia Guerra-Santin, Sacha Silvester
TUDelft, Industrial Design Engineering

Thaleia Konstantinou, TUDelft, Architecture



The 2ndSkin solution

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A number of second skin solutions have been developed in recent years to solve the problem of large scale renovation of housing. The 2ndSkin approach presented in this paper is currently under development by a consortium of academic and industry partners in the Netherlands. The objective of the 2ndSkin project is to develop a strategy for an integrated and effective renovation solution. This approach aims at developing a marke tready zero energy solution that can be applied to rental apartment blocks in the Netherlands. The project will develop a process for post-occupancy monitoring and evaluation to provide feedback to users to ensure the zero-energy target. The 2ndSkin approach seeks a zero energy target regardless of the user. Thus in this approach, both building–related and user related energy consumption are considered within the strategy. The objective is a solution that is zero energy regardless of the type of occupancy of the building. The strategy also aims at developing an integrated approach in which the user is part of the renovation strategy from early stages of the development in order to increase the acceptability of the renovation process and the understanding of the functioning of the systems. In addition, The WoON 2012 Dutch database was used to determine occupancy profiles for building simulation. Through statistical analysis, seven household types have been identified. Seven different occupancy profiles, based on the household types and seven occupancy factors created through Factor Analysis have been defined. Results of the pattern compositions are presented. The results of this investigation aim to inform the design process.

KEYWORDS: *Occupancy profiles, renovation, zero energy, second skin façade, building simulation*

ENERGY PERFORMANCE OF OFFICE BUILDING IN SANTIAGO, CHILE: RESULTS OF UNREGULATED ENVIRONMENTAL BUILDING STANDARDS IN A HIGH RADIATION CLIMATE

Claudio Vásquez Zaldívar
Pontificia Universidad Católica de Chile

Renato D'Alencçon Castrillón
Technische Universität Berlin

Regions around the word with the same climate of Santiago, Csb (temperate warm with winter rain), according to Köppen's classification. Source: Alejandro Prieto, 2011

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In Chile, non-residential buildings are not subject to regulations in regard of energy consumption or indoor environmental quality. With the exception of urban aspects related to volume and sun obstructions, other aspects such as energy performance or façade performance are left to the market's ability to define without any standards or models of adaptation to the country's climate and energy conditions. Santiago, the capital, concentrates most of the office buildings, where this development has turned critical due to the widespread use of architectural models based on highly transparent façades, associated with economic success and trans-nationalization, but little consideration of Santiago's temperate-warm climate.

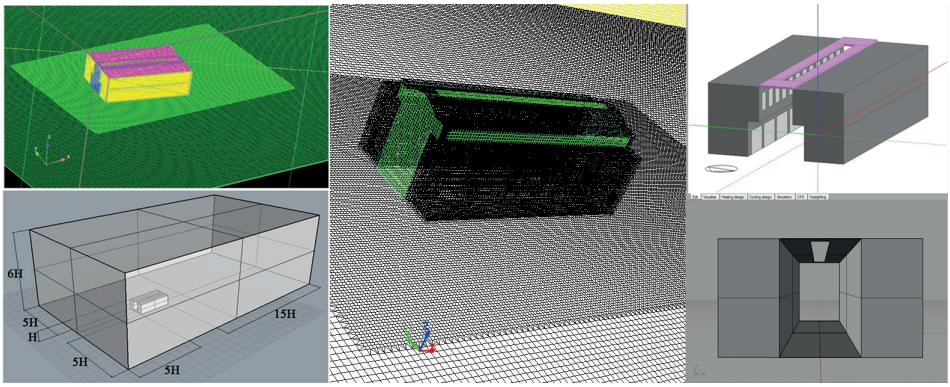
This paper presents the results of a currently ongoing measurement campaign considering nine representative buildings selected by types according to the characteristics of its architecture and façade systems. Measurements considered energy consumption, indoor environment quality, performance of the façades systems and user satisfaction. The results obtained in the spring and summer, critical periods of the year in Santiago's climatic context, will be presented. The conclusions of the study show results in two areas: the role that architecture plays in the energy performance of buildings and the results obtained when the market regulate building performance by its own.

KEYWORDS: *Glazed Façades, Regulations, Consumption, Comfort, Temperate Climate*

COUPLING BUILDING ENERGY SIMULATION AND COMPUTATIONAL FLUID DYNAMICS: APPLICATION TO A SEMI ENCLOSED URBAN STREET IN A HOT ARID CLIMATE

Mohamed H. Elnabawi
Phd Candidate Newcastle University, UK

Dr. Neveen Hamza, Dr. Steven Dudek
Newcastle University, UK.



The existing case study the CFD model and meshing domain

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The paper aims is to investigate the thermal performance underneath an existing shading design for an urban alleys in the hot arid context of Cairo in Egypt. CFD programs can accurately describe the air velocity and temperature distribution if all of the heat factors are set as dynamic boundary conditions and heat generators. However, this method is computationally very expensive and almost impossible to perform for a long-period energy simulation. Alternatively, an integration of building energy simulation (BES) and Computational fluid dynamics (CFD) can eliminate many of these assumptions, as the two models exchange the appropriate boundary conditions. Therefore, Designbuilder as BES handles the external surface temperature for the main building surrounding the street or the semi- enclosed areas, while Fluent as CFD simulates the street air flow and air temperature. The paper describes an integration framework through the transfer of enclosure surface temperatures from BES to CFD, The numerical results were validated and compared to the experimental ones. The results from applying the framework show how building thermal performance interacts with specific outdoor microclimates. This study shows the importance of outdoor and indoor coupled assessment at microclimate level to deploy passive design features to changing climate and mitigate urban heat island.

KEYWORDS: *Computational fluid dynamics (CFD); building energy simulation (BES), thermal comfort Temperature distribution*

METHODOLOGY TO ANALYSE THE ENERGY EFFICIENT REFURBISHMENT POTENTIAL OF BUDAPEST HISTORICAL DOWNTOWN AREA

Ida Kiss, Diana Apró, Dr. András Reith PhD
ABUD Mérnökiroda Kft.

Attila Talamon
Hungarian Academy of Sciences

Budapest historical downtown (Apró, 2015)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Europe has a great tradition of urbanization. Dating back to the 13th-12th centuries BC, our oldest urban settlements were founded as important centres of economy, culture and transport. The great construction boom of the late 19th century shaped, transformed and structured strongly the now historical city centres that show several similarities, and their buildings represent large part of the European urban building stock. Most of these buildings are subject of preservation, raising difficulties in applying energy efficient refurbishment measures. The aim of this study is to develop a methodology - that could be also applied to European cities, due to their similar characteristics -, for examining how the energy-performance of the existing building stock in historical downtown areas could be improved through the case study analysis of the central downtown district of Budapest, the capital of Hungary. As an example from the most typical building class of the above typology, a multi-residential house built in mid-19th century is analysed in details. The analysis method is based on the comparison of calculated energy consumptions of the base case building with the refurbished case. The result indicates that although the renovation measures are very limited due to heritage protection, the operational energy consumption could be reduced with at least 60% annually; furthermore, some part of it could be covered from on-site renewable energy source despite of the density of the built-up area. The result of the applied methodology is the assessment of energy reduction potential of the entire analysed district area in line with the economic feasibility of the possible complex retrofit programme. The steps of the methodology are summarized to be expandable to estimate the energy saving potential of other European cities that has a great relevance for future policy making and creation of new business models in urban regeneration processes.

KEYWORDS: *URBAN REGENERATION; ENERGY SAVING POTENTIAL; DISTRICT SCALE RETROFITTING; EPBD; NZEB*

ANALYZING THE EFFECTS OF DENSIFICATION ON AIR QUALITY AND URBAN HEAT ISLAND IN FIVE PARISIAN NEIGHBOURHOODS

Alberto Ortiz - EIVP & UMons
Jean-Marie Cariolet, Morgane Colombert - EIVP
Vincent Becue - UMons

The five Parisien neighbourhoods (Google Earth, 2015)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

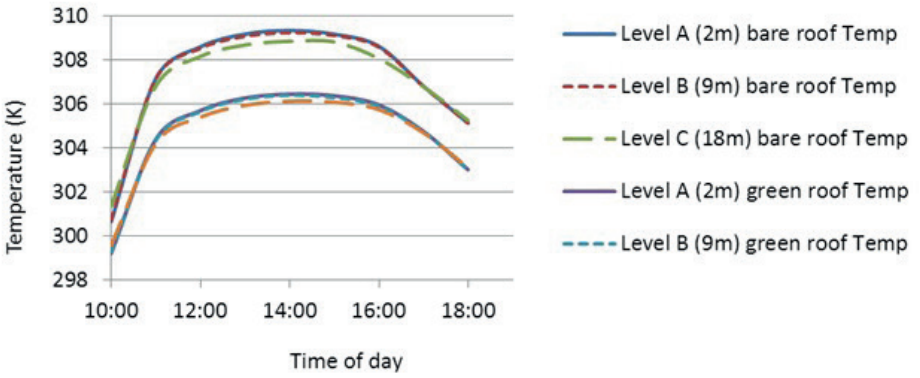
The heat wave in 2003 has caused 14,800 deaths in France, most of these in cities where urban heat island has intensified mortality (INVS, 2003). Air pollution is another phenomenon that also intensifies summer mortality (Pascal et al., 2014). Urban Heat Island (UHI) and air pollution are very complex phenomena and share a common parameter: high urban density. Density factors have been linked to the UHI (Oke, 1973) and form factors with contaminant concentration (Chan et al., 2003). The complexity of pollutants and temperature spatialisation and the heterogeneity of the city make it difficult to study the links and interactions between these phenomena, so we will not be concerned by this question. In our research, five Parisian districts have been selected on criteria of homogeneity of the built environment. A first diagnostic of neighbourhoods was performed and three densification scenarios were proposed. The first scenario is the increase of buildings height. The second is to build inside the courtyards of buildings. The third scenario is a combination of both. The diagnostic and the three scenarios have been simulated in the ENVI-met software, which can model the weather conditions and the sources of air pollution. Thanks to these simulations we founded interdependencies between Sky View Factor (SVF) and dissipation of pollutants and air temperature. The densification reduces the direct sunlight resulting in a decrease of the potential temperature. However this SVF reduction leads to lower dissipation contaminants. This result leads to antagonisms between actions favourable to air quality or temperature and invites to further reflection on these phenomena. Densification is an urban planning option, but more studies are needed in order to know what are its advantages and disadvantages.

KEYWORDS: *Densification, urban heat island, air quality, Paris, scenarios, urban typologies, ENVI-met*

IMPACT OF GREEN ROOF ON URBAN CANOPY LAYER MICROCLIMATES IN A PLANNED RESIDENTIAL AREA OF DHAKA, BANGLADESH

Ruksana Afroz, Khandoker Tariqul Islam, Khandaker Shabbir Ahmed

Bangladesh University of Engineering and Technology



Uttara residential area in Sector 13, Dhaka and respective simulation model

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The mean temperature of Dhaka, the capital of Bangladesh is increasing at an alarming rate in contrast to its adjacent townships. This over-populated 500 sq.km city suffers from lack of green space and is thereby affected by the urban heat island (UHI) effect. Previous studies have identified green-roof's roles in cooling and energy-conservation indoors. However, limited is available on its wider influence on neighborhood microclimate and human thermal comfort at canopy layer.

A field survey was conducted at a planned residential area Uttara in Dhaka, Bangladesh. There is no green roof in that area. Dry Bulb Temperature (DBT), Relative Humidity (RH) and Wind Speed (m/sec) data collected at 10:00 AM were 307.10±2.39 K and 67.46±5.06 % respectively. These data were used to simulate microclimate of an exact model of that area.

Three dimensional microclimate model of the streets were simulated in ENVImet® in two stages. At first, the area models were simulated with outputs without green roof. In the second stage, the same area models were simulated after applying green roof to observe the extent and direction of changes in the microclimates of three urban canopy Layer A (2 meters), Layer B (9 meters) and Layer C (18 meters) using Student's 't' test.

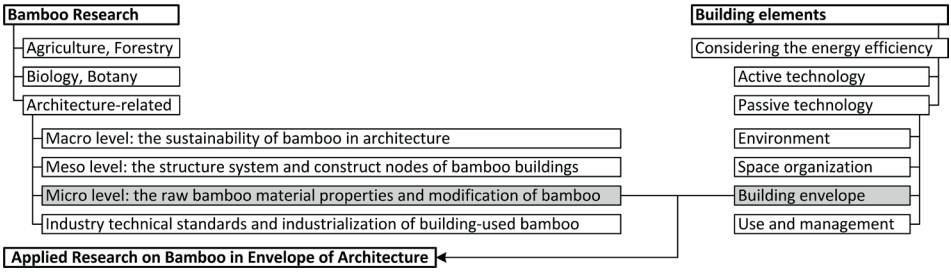
We have found that the impact of green-roof on temperature of urban canopy layers is significant ($p<0.01$, CI: 95%). The green-roof cooling effect is not restrict to the rooftops but also extends to the ground. Relative humidity was found to be unaffected by green roof ($p>0.05$, CI: 95%). These findings reflect the prospects of green-roof installation for cooling, mitigating urban heat island effect, and providing more comfortable thermal environment for urban residents.

KEYWORDS: *Green roof, Urban canopy, Microclimate, Residential, Thermal comfort.*

MANUFACTURING CLASSIFICATION OF BAMBOO AND COMPARATIVE STUDY ON SEVERAL PHYSICAL PROPERTIES, SPECIALLY CONSIDERING THE APPLICATION IN BUILDING ENVELOPE

Yimin Sun, Zujian Huang, Wang Pan

School of Architecture, South China University of Technology



the position of applied research on bamboo in envelope of architecture in the frame of related researches

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The search and development for ecological building materials has become hot gradually. As a natural material, bamboo possesses excellent physical performances. Modern bamboo modification technologies can make up for the deficiencies of its chemical properties, which make it practicable to be a building material. Compared with those structural components, building envelope requires less in mechanical properties, corrosion resistance and service life. but more in thermal, acoustic and optical properties. It is logical and available for the application of bamboo in building envelope. (Fig 1)

The paper aims to explore the potentials of bamboo for architecture, which promotes a sustainable industry to society and economy, an environmental-friendly construction mode, and a comfortable human settlement, and provide basic data and general qualitative judgments in material dimension for the application of bamboo in building envelope. Firstly, the paper makes a clear classification for bamboo, distinguished from the manufacturing process. Secondly, considering the special requirements of building envelope to the materials, the study collects data and tests several physical properties for the typical bamboo products, mainly including the mechanical performance, thermal performance. Finally, through the test and groups of comparative analysis, the paper gives a summary of physical performance and advantage evaluation for the series of bamboo materials, in terms of the application in building envelope. The outcomes further show the sustainability of bamboo, the applicability of bamboo in building envelope, and the improving effects of modification technologies.

KEYWORDS: *BAMBOO, RAW BAMBOO, MODIFIED BAMBOO, BUILDING ENVELOPE, PHYSICAL PERFORMANCE*

ENERGY MANAGEMENT OF THE ORGANIC FRACTION OF MUNICIPAL SOLID WASTE. CASE STUDY: MULTIFAMILY HOUSING OF THE CITY OF MEDELLIN, COLOMBIA.

Maria Victoria Valencia Morales, Catalina Morales Maya, Guillermo Penagos García - PVG Arquitectos

Alexander Gonzalez Castaño - Universidad Pontificia Bolivariana

La Pradera, Landfill (source: www.eluniversal.com.co)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

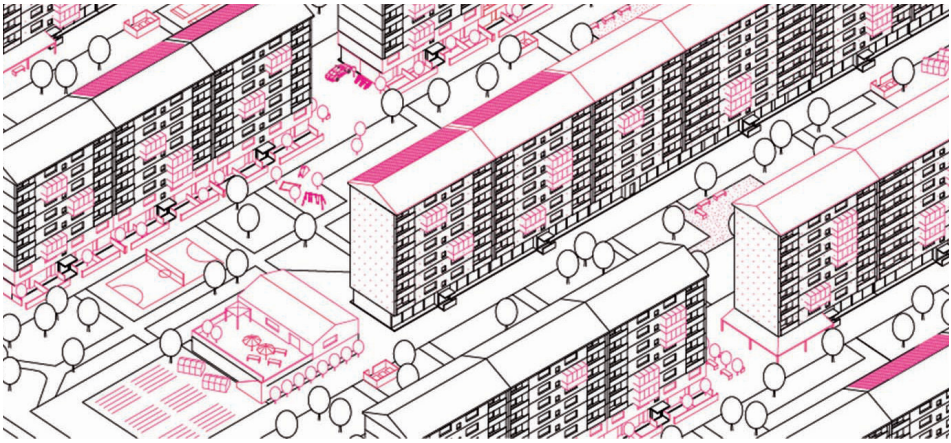
The global problem of production and final disposal of the municipal solid waste, has today a greater environmental impact due to economic growth, the industrial development and the increase of population in urban areas. In the case of Colombia, the inefficiency in the solid waste handling process does not consider the possibility to benefit from the physicochemical and microbiological properties of the organic fraction of the municipal solid waste (OFMS). Situation which has great environmental, social and economic impacts. The purpose of this study, was to evaluate the potential that the Organic fractions has as an alternative energy source, through a recovery system based on the use of its physicochemical and microbiological properties, and to propose suitable areas for the storage of waste in housing units and complexes, to potentiate a management system that favors waste separation at the source. To this end, based on the amount of municipal solid waste produced, a mass balance was performed considering an anaerobic digestion system for a wet single-phase process, which allowed to calculate the amount of energy (kWh/day) that the transformed organic fraction can produce. In the same way, the required area for an appropriate storage of the waste produced within the housing unit was estimated, and the procedure to calculate the amount of area necessary for a common waste storage facility within the residential complex, according to the number of housing units, is described. According to the results, the amount of energy resulting from the application of such a system could meet the energy demand of almost 4,000 households. Thus, this initiative is not only an alternative source for energy generation, it is also a strategy that has great potential to provide solutions to many current environmental problems.

KEYWORDS: *Organic Fraction of the municipal solid waste (OFMSW), alternative energy sources, Multifamily Housing, Solid waste storage.*

INCUBATORS OF PUBLIC SPACES (1): GRASSROOTS REGENERATION OF NEIGHBOURHOODS

Mauro Berta, Federica Bonavero, Luca Caneparo, Davide Rolfo

Politecnico di Torino



Mirafiori Sud neighbourhood.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Incubators of Public Places Project aims to provide the means to grow and care for places. What makes a place is the integration of spatial forms, buildings and open spaces, that foster the interactions of people, as they inhabit those spaces. Inhabitants are asking for a better quality of life; this need is often expressed by even minute requests. The governance of these requests and their organization into a coherent city vision is one of the challenges of "grassroots planning". IPP experiments linking agreed visions for the positive change of an urban area with the combination of individual self-interest driven actions on the same area.

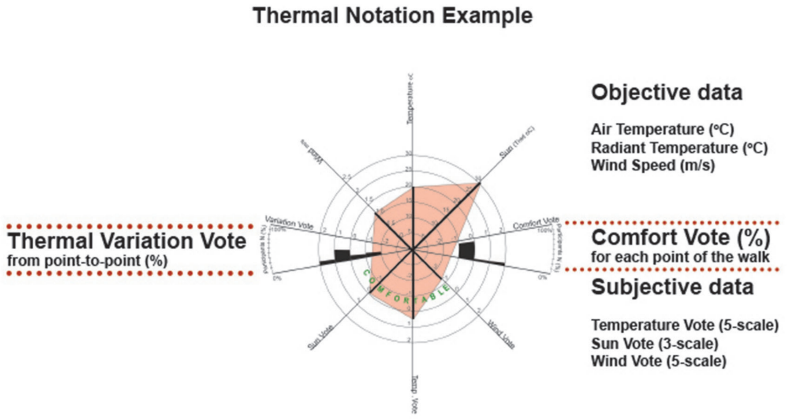
Given the budget constraints of most Municipalities and the conjunctural shortening of private partnerships, Incubators fosters self-organisation in the financial support to the transformations. Through the active co-creation, the Project encourages the stakeholders' ability to orient dynamically towards shared objectives. Further self-organisation is in the financial support to the transformations, through incremental lending and co-investing. Incubators is defining new ways of producing credit to support regeneration on a variety of levels, and differentiating the financial assistance. Particular attention is devoted to activities with social value, those able to speed up the social impact on a neighbourhood.

KEYWORDS: *Urban Vision, Crowdcreativity, Microfinance.*

THERMAL PERCEPTION OF PEDESTRIANS MOVING IN INTERCONNECTED URBAN SPACES: ADAPTIVE THERMAL COMFORT IN IRREGULAR SPATIAL SEQUENCES IN ROME AND LONDON

Carolina Vasilikou, Marialena Nikolopoulou

University of Kent



Thermal Notation, a design tool in order to assess pedestrian thermal perception and comfort

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

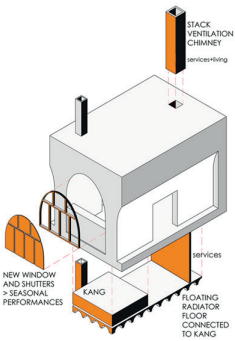
Complex urban morphology and walking activities affect the thermal comfort of pedestrians. Spatial sequences in historic city centres provide an example of resilient evolution of walking environments and adaptation to pedestrian use and social vitality across ages. However, adverse weather conditions may create thermal stress and discomfort that may ruin the pedestrians' experience of outdoor spaces. The paper is presenting the finding of a 3-year study on the variation of thermal perception and comfort between interconnected spaces for pedestrians in movement. Two spatial sequences of 500m length in Rome and London have been examined in terms of morphological variation and thermal pleasantness and comfort through the methodology of thermal walks. The researcher conducted simultaneous monitoring of microclimatic variation and the subjective perception of thermal comfort of 190 participants. The findings suggest that the urban morphology of interconnected spaces has a small impact on microclimatic variation but a large influence on the thermal comfort of participants. Results show that spatial sequences of high density create a differentiation of thermal pleasantness between urban canyons and squares. The irregularity in the geometry of spaces along an urban sequence seems to enhance thermal diversity. The overall thermal walk evaluation by participants showed that the experience of extreme discomfort or comfort during the walk may be singled out. The new ability to understand the microclimate of irregular spatial sequences multiplies the choices of the urban designers. Through the application of the design tool of thermal notation (Fig 1), the thermal perception of pedestrians may become a measure of spatial quality and illustrate the theory of adaptive thermal comfort as design approach that harmonises climate-sensitive urban interventions with the act of walking.

KEYWORDS: *THERMAL COMFORT, SPATIAL SEQUENCES, THERMAL PERCEPTION, URBAN MORPHOLOGY.*

ENVIRONMENTAL PERFORMANCE OPTIMIZATION OF A HISTORICAL COURTYARD HOUSE IN CHINA

Luca Finocchiaro, Ana Despa Mihaela, Harald Høyem,
Lisbet Sauarlia, Tore Haugen
Norwegian University of Science and Technology

Fu Xiu-zhang
Southeast University



The courtyard house analysed at the Hou Ji village.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Houji is a small village of high historical and cultural value, located in the northeast of China, a few kilometres away from Pingyao, a UNESCO world heritage site. Life in Houji is usually related to farming traditions and provides to its inhabitants low income and hard work. Historical dwellings, despite their unquestionable architectural beauty, offer rather poor living conditions. This encourages the young and active generation to seek work and a more modern life in the city, leaving a population dominated by children and the old behind. A research project aiming at identifying a set of guidelines for the upgrade of historical housing conditions towards a more modern and comfortable lifestyle was thus initiated in collaboration with Chinese university and institutions. The research project has been structured in three work packages analysing, respectively, historical and cultural values, people needs and socio-economic trends, environmental and energy performance. In this paper the results of analyses conducted in a significant historical house in the Hou Ji village will be presented. Monitoring and simulation of the house have been carried out with the purpose of estimating the environmental performance of the house. A bioclimatic chart of possible interventions aiming at improving its environmental performance has thus been edited in relation to data collected interviewing the village inhabitants in the other work packages.

KEYWORDS: *Environmental, Performance, Analysis, Comfort, Climate, Modern, living, China.*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Improving perFORMance

1st Parallel Session

DAY 1

14:00 – 16:00

CHAIRMEN

Simos Yannas ..... Table 7
Brian Ford ..... Table 8

MFREE-S^{CCF}, HIGH PERFORMANCE FAÇADE SOLUTION FOR AUSTRALIAN CLIMATES

Raymond Lumantarna (PhD)
Marc Zobec (PhD)

PERMASTEELISA

200 George Street, Sydney

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

One of the main present challenges in the construction industry is to achieve sustainable and environmentally responsible development. As the main component of a building envelope, which is exposed to external environmental conditions, there are increasingly stringent performance requirements imposed on the façade system in order to achieve sustainability goals. The traditional single skin façade system typically does not meet performance requirements without external shading devices, significant reduction in window to wall ratio and reduction in light transmittance. On the other hand, although it has been proven to achieve desired performance requirements, a double skin façade system is not without a significant disadvantage in economical cost. The mfree-SCCF façade system is an innovative closed cavity system developed by Permasteelisa Group. The mfree-SCCF façade system combines the benefit of transparent facades (provision of daylight and external views), whilst meeting multiple stringent performance criteria such as low building energy consumption, high thermal and acoustic comfort, increased 'effective' net-lettable area, as well as low long-term maintenance costs.

KEYWORDS: *Energy Efficiency, thermal performance, façade*

THE GIRL SCOUTS OF UTAH INTERLOCKING CROSS-LAMINATED TIMBER SUMMER CABINS

Joerg Ruegemer, Erin Carraher

University of Utah

Finished cabins in their natural environment

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

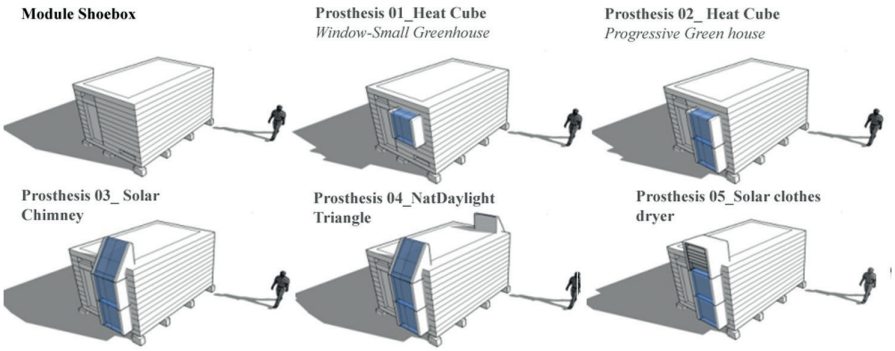
Research Summary

This paper discusses the design, development and construction of three, 600ft2/56m2 gross area summer camping cabins for a Girl Scouts' Ranch Camp in the United States of America. When developing the design for the cabins, the authors as the organizing team took an integrated, multidisciplinary design and development approach in which stakeholders, architecture faculty, general contractor and fabricator, engineers, the building department, Girl Scouts, and architecture students were involved. The cabins were designed and built in collaboration with a local timber company that focuses on natural building methods using no glues, binders, adhesives, or products with VOCs. That company, in collaboration with researchers of the local university, has developed an innovative and highly sustainable material called Interlocking Cross Laminated Timber (ICLT) to incorporate locally sourced wood damaged by pine beetle infestation prevalent in the American West into the assembly of solid wooden panels. Utilization of this new material puts the project at the forefront of sustainable construction with findings expected to influence the construction market within the region and well beyond. The paper analyzes the project's construction with a specific focus on experiences and challenges anticipated during the design and construction process when using a material that is new to the US and local building industry.

KEYWORDS: *Interlocking Cross-Laminated Timber; Sustainable Design; Design and Education, Participatory Development Process.*

SMALL-SCALE ARCHITECTONICS PROSTHESIS. AN ADAPTIVE STRATEGY FOR INTEGRATION OF BIO-CLIMATIC DEVICES IN PROGRESSIVE SOCIAL HOUSING REFURBISHMENT

Leonardo Agurto - ARQ-BIOCLIM-PROSTHESIS
Pedro Orellana Agüero, Adelqui Fissore, Jimmy Ulloa, Daniela López Castro, Francisca Tapia Villa - University of Concepción - Chile
Nurhan Abujidi
José Antonio Turégano - University of Zaragoza



Example of modularity and escalation. Implanting and combining prosthetic components on a module.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Social housing refurbishment from an environmental perspective is an urgent necessity. There is a big percent of existing buildings and social housing stock that doesn't respond to the specific local environmental conditions because their year of construction with expired legal frameworks, functionalities outdates, cheap housing or were built on scarcity contexts. All these examples have an enormous potential of adaptation and bioclimatic refurbishment it's necessary to improve the living conditions. The dual relationship between energy and transitional space in housing is fundamental and should be reclaimed for the double functionality that these spaces do. We argue that transitional inside/outside spaces have the potential to be integrated as an extension of the domestic space to increase their socio-spatial and environmental functions. Under this logic, a progressive and low cost strategy is created and developed to transform bioclimatic and spatial solutions in a catalogue of adaptive open source small components. Therefore, the relationship between the existing and the new parts of a refurbished building need to be analysed and developed on conceptual and implementation levels. It further aims to develop a micro-architecture concept by integrating the prosthesis conception as a techno complementary element into the natural functions of building. Prosthesis is seen in these proposal as the injection of an energetic, socio-spatial and environmental patterns, as issues that are absent on baseline situation. Today, this project is being developed from a PhD thesis to a real "research by design" experience financed by regional funds from INNOVA BIO BIO Chile; and it is creating an incremental housing and open source catalogue of low-cost components.

KEYWORDS: *Bioclimatic refurbishment, Incremental retrofit, Social housing.Insert*

ANALYTICAL METHOD TO ASSESS OUTDOOR COMFORT BASED ON UNIVERSAL THERMAL CLIMATE INDEX (UTCI)

Navid Hatefnia, Marjan Ghobad

PJCarew Consulting

The most sense from 'extreme cold stress' to 'extreme heat stress' Kimberly- Jul 1st - Sep 30th 7:00-15:00

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Environmental analysis, as part of the initial design process, requires precise consideration of the bioclimatic conditions within the local context of a site. The daily growth in inter alia knowledge of effective parameters in environmental conditions, quality weather data and human thermo-physiology studies all contribute to improve potentials for achieving a relatively accurate analyses of environmental conditions by overlaying all the climatic and thermo-physiological data. This paper describes a method for examining different points within the same context using all the input data available to understand the corresponding comfort condition levels, thus assisting in better decision-making at early design stages. The proposed approach starts with a simplified computer model of a site divided into a matrix of nodes. Information about the site, climate, human thermo-physiology and behavioural aspects among others are collected and each data parameter is matched and analysed to the context of every node on the model through a series of specific algorithms. Thereafter, the data from the nodes are cleaned, classified and integrated based on the Universal Thermal Climate Index (UTCI). The results obtained using this method, can be tailored according to the desired outcomes. The proposed method identifies effective factors for comfort condition improvement at different points on the site. It also provides a means to prioritise specific parameters so that they can be manipulated for optimal design solutions, ie. Parameters can be aligned to desired conditions in specific parts of the site with that aim to optimise outdoor space usage.

KEYWORDS: *Microclimate, Outdoor comfort, Urban design, Environmental aspects, Bioclimatic conditions.*

PERFORMANCE BASED INTEGRATION FOR ENERGY AND ENVIRONMENTAL RETROFITTING IN CHILEAN SOCIAL HOUSING

Paulina Wegertseder, Maureen Trebilcock

Universidad del Bío-Bío

Example of a social house in Chile

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

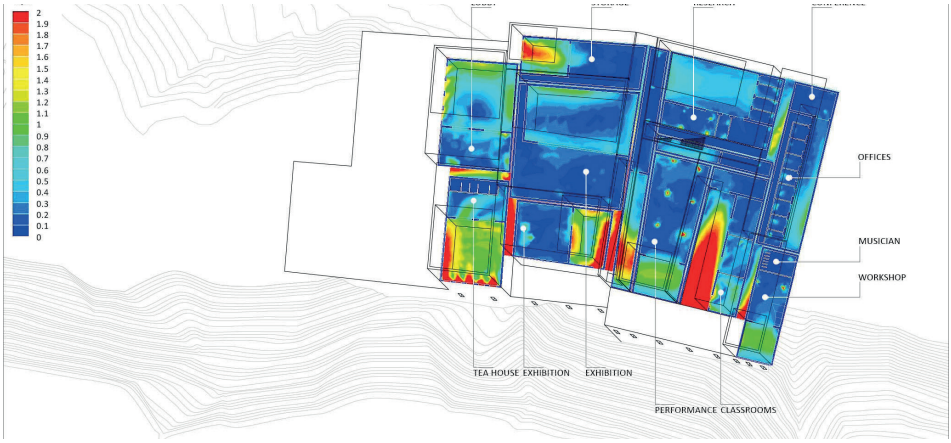
A large percentage of existing housing was built without thermal and energy efficiency considerations, causing high energy consumption that users must assume to keep house in comfort conditions. In Chile, at least 75% of existing houses were built without thermal regulations. This situation mainly affects vulnerable families, who live under the line of "fuel poverty". The government has sought to improve this by retrofitting measures, but only involving a few performances that have implications on energy demands and thermal comfort. Besides, these performance are applied independently of each other, regardless of the relation between them and the resulting effects. This research aims to cover a knowledge gap of how different performance based act comprehensively in the housing energy-environmental retrofitting (HEER). From a Post Occupancy Evaluation (numerical calculations, energy simulation, monitoring and user perception) made in case studies, it was determined that three performances must be improved: Thermal Comfort, Energy Efficiency for Heating Demand and Indoor Air Quality. Different variables for each performance are proposed, whose relevance is analysed under a multifactorial study, showing that the relevant variables in the housing energy-environmental retrofitting are: thermal transmittance of walls, air infiltration rate in the envelope and using a ventilation system. But, this improvements should be considered in a holistically way to get better standards and under a performance based philosophy to put focus on the final goal and not in a particular strategy.

KEYWORDS: *Energy Environmental Retrofitting, Social Housing, POE, Chile, Multifactorial Analysis*

POETICS OF AIRFLOW IN ARCHITECTURAL DESIGN: THE CASE OF BAMIYAN CULTURAL CENTRE PROPOSAL

Anđela Karabašević
Faculty of Architecture - University of Belgrade

Vladislav Sudžum
Faculty of Mechanical Engineering - University of Belgrade



Bamiyan Cultural Centre proposal: air flow patterns

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This research explores air as a primary carrier of the atmospheric spatial qualities, such as heat, vapour and odour, and as a mediator between human body and the environment. With the assumption that patterns of air flow within a building are inextricably linked to the subjective experience of space, we investigate the hidden poetics of aerial processes in architecture, on an example of a project proposal for a Cultural Centre in Bamiyan Valley, Afghanistan. In response to the existing hot and arid climate conditions on one side, and a long history of political conflicts, poverty and fear on the other, we chose a traditional Afghanistan courtyard house as a locally familiar vernacular model to further build upon. We pursued an economic structure that provides locally familiar ambiances and a sense of safety and identity. The investigations of air flow characteristics of this sofisticated climatic device led us to a series of conclusions on the relations between physical structure and aerial behaviour of the courtyard house, which we further implemented in our conceptual design of the centre. Multiple courtyard system was developed as a complex atmospheric mechanism that modulates the existing natural processes to construct specific atmospheric conditions inside in relation to the proposed cultural programme. In this way, architecture becomes an integral part of the local ecosystem. Carefully orchestrated aerial behaviour significantly contributes to a humane design approach, one based on people needs and their immediate experience of space. Our aim is to transcend the common discrepancy between the bioclimatic strategies on one side and atmospheric - sensorial - design on the other, aiming towards a holistic approach that considers both equally important.

KEYWORDS: *AIR FLOW, ARCHITECTURAL ATMOSPHERE, ATMOSPHERIC DESIGN, COURTYARD HOUSE, MULTIPLE COURTYARD SYSTEM*

STRAW-BALE WALLS FOR SUSTAINABLE ARCHITECTURE: IMPROVING AND PROMOTING THE USE OF STRAW-BALE USE IN EUROPEAN BUILDINGS

Arnaud Evrard, André De Herde - UCL Architecture et Climat
Benjamin Biot, Gauthier Keutgen - ICEDD
Frédéric Lebeau - ULg-Biose
Luc Courard - ULg-GeMMe

Straw-bale wall studied, prefabricated in Wallonia

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Straw-bale use in buildings may be an interesting way to decrease our energy needs and our impact on the environment. Moreover, it fosters a local economy and the creation of new jobs in the building industry. Combined with earth materials and other well-selected materials and systems, it allows creative designers to integrate highly efficient, low-tech and reusable envelopes in comfortable and healthy places. The present paper summarizes the results of a four year R&D program aiming to improve and promote the use of straw bale in buildings and also to remove uncertainties concerning this use.

Three main aspects are pinpointed and discussed: hygrothermal transfer and storage in straw-bale walls, regulation of indoor conditions and environmental impact in the long term. These three topics were submitted to European experts (France, England and Germany) in order to discuss a cross-comparison of results obtained on a larger scale.

The paper shows that straw-bale use in buildings is a relevant and innovative solution in facing one of the major challenges of today and tomorrow: "How to build/ transform comfortable and affordable buildings with local resources and with a positive impact on the environment?".

KEYWORDS: *Straw-bale; hygrothermal transfer, storage and regulation; environmental impact*

DATA DRIVEN HIGH PERFORMANCE BUILDINGS AT INFOSYS CAMPUSES, INDIA

Nishita Baderia, Sridhar Chidambaram, Chetan R
Green Initiatives - Infosys Ltd.

Guruprakash Sastry
Infrastructure - Infosys Ltd.

Inefficient to Efficient Buildings at Infosys

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

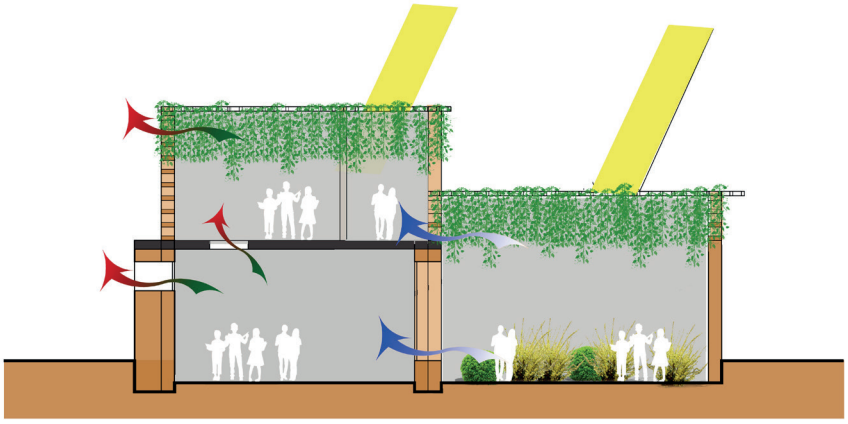
The World and Economy are changing, sustainable design is now on boardroom agendas of a lot of corporate houses. Infosys, a large IT company in India, is also adopting sustainable design principles for its campuses in India. Initially, the building designs were dominated by subjective taste, experience and intuition of designers. Since 2008, the company started moving towards sustainable design. It was realized 'what is not measured, cannot be improved'. Hence, in order to optimize, the company started monitoring the performance in terms of thermal comfort, daylight quality, and energy and water consumption for all existing and new buildings. Building data is captured and monitored by means of sensors, energy and water metering, spot daylight measurements and occupant surveys. Advanced performance metrics and technology have changed how buildings are being conceived; developed; and operated. Based on the analysis of monitored data, existing building operations are being made more efficient. This data is aiding in planning for façade as well as system retrofit solutions for existing buildings and in formulating benchmark performance parameters for new buildings. These benchmarks are provided to every building consultant including the architects as design guidelines to which they have to strictly adhere to. All design and retrofit decisions for new as well as existing buildings are data driven and not based on assumptions and thumb rules. Through continuous performance monitoring and verification, Infosys has been able to implement and optimize design solutions such as splitting of window into daylight and vision pane, suspended luminaires with direct/indirect lighting, efficient system design, radiant cooling and granular level monitoring. This has resulted in buildings that are highly efficient, cost effective to build and operate and also provide a comfortable, healthy and safe environment for employees.

KEYWORDS: *DATA DRIVEN DESIGN, INTEGRATED DESIGN PROCESS, BENCHMARK PERFORMANCE PARAMETERS, HIGH PERFORMANCE BUILDINGS*

BIOCLIMATIC DESIGN APPROACH APPLIED TO THE PRIMARY SCHOOLS IN RURAL AREAS OF TURPAN, XINJIANG, CHINA

Wei ZHU
Xi'an University of Architecture and Technology

Zhuo WANG
China Northwest Architecture Design and Research Institute



Bioclimatic section in summer of prototype primary school in Turpan

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Visual and thermal comfort degrees in the learning environment influence the productivity of students and teachers. To provide students comfortable learning environment has been considered as a top priority in primary schools in developed countries. However, in China, the environmental performance in primary schools is often ignored, especially in rural areas and these regions lack in techniques, resources and funds when designing a new school building. This paper focuses on a specific region - Turpan, Xinjiang, China, and this region belongs to a hot and arid climate zone. This paper aims at discussing how the bioclimatic design approach could provide primary school in this region good learning environment and achieve cost and energy efficiency at the same time. It is believed that vernacular buildings adapt to the specific climate conditions here very well by means of using traditional ways. Thus, based on in-depth analysis of local climatic conditions, this paper explores the vernacular buildings in Turpan to look for these traditional ways. The conclusions are drawn from the analysis of climate condition and the bioclimatic design strategies applied in vernacular buildings in Turpan, Xinjiang. A potential bioclimatic section for the prototype of primary school in Turpan is presented in the conclusion. The paper hopes to find a compromise solution, taking advantage of the available resources and building techniques instead of using expensive technology so as to achieve a good learning environment.

KEYWORDS: *PRIMARY SCHOOL, RURAL AREAS, BIOCLIMATIC DESIGN, GOOD LEARNING ENVIRONMENT*

PASSIVE TOWN KUROBE MODEL - A SUSTAINABLE COMMUNITY PROJECT IN KUROBE

Yuichiro Kodama - Kobe Design University
Naoshi Kaneko - ESTEC-Design, Tokyo
Futoshi Miyaoka - Nihon University
Koji Takemasa - LEAD Labo
Khuplianlam Tungnung, Bruna Bajramovic - Kobe Design University

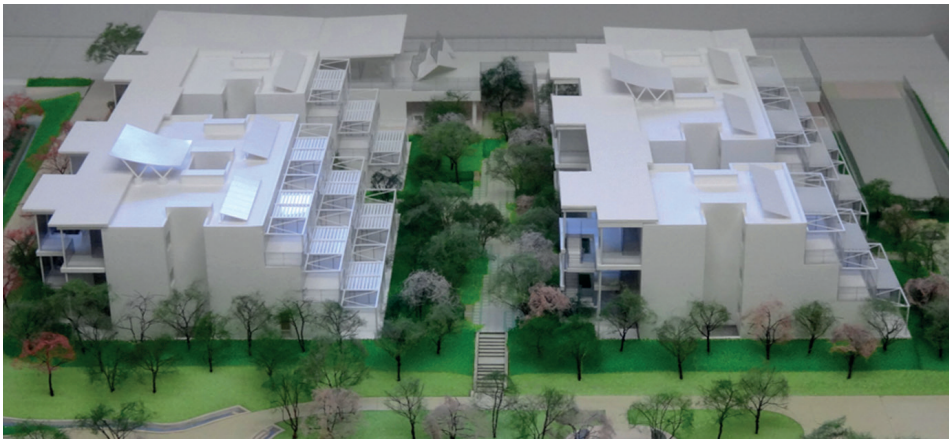


Image illustrating passive design techniques, such as: sun terraces, wind vane, solar panels and social community spaces in the courtyards, river side plaza, pathways, and north interface communal plazas.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

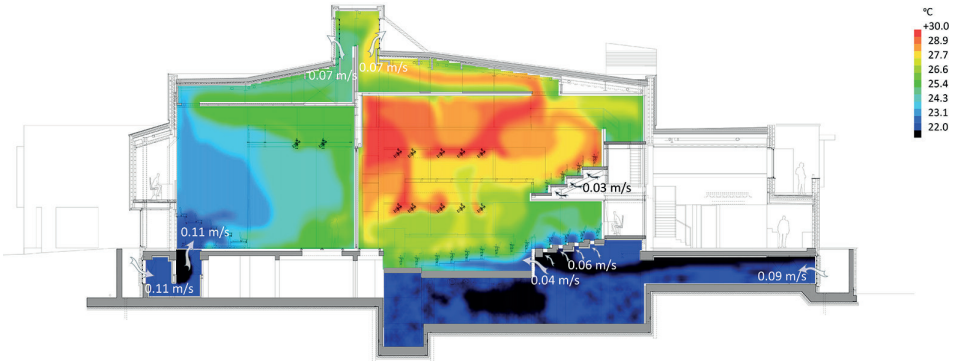
Passive Town Kurobe Model is conceptualised to be a sustainable community project in Kurobe City, Japan with a population of about 42000, and home to several international industries. This housing complex with 36 units will be rented to the employees' families and other citizens. The construction is scheduled to be completed in March 2016. As a possible model of Sustainable Community for the near future, the project aims social, economic, and environment solutions through the use of high natural potentials of the region, low-energy passive design techniques in the building and landscape towards reducing high energy consumption, symbiotic and responsive living with the social and natural environment milieu to activate the local community. "Advanced Passive Climate Charts" and other design tools are utilized to discuss design strategies with relevant details. Natural comfort is expected to be accounted for by utilizing the local climate potentials, such as: warmness, coolness according to the varied seasons while envisaging new lifestyles open to nature as well as the social environment. Energy consumption in the apartment is expected to be reduce through the use of passive design techniques, renewable bio-energy and solar panels, and active mechanical systems. The project is envisaged to be a possible local solution for global issues to respond to social-lifestyle changes and peoples' needs, and supplementing economic necessities through reduce energy and water consumption, and a possible alternative solution to the nature-human dichotomy in some modern habitats milieu.

KEYWORDS: *SUSTAINABLE COMMUNITY, PASSIVE DESIGN, ENVIRONMENT, CLIMATE, SOCIAL, ECONOMIC.*

THEATRE DESIGN AND NATURAL VENTILATION: A UK CASE STUDY

Brian Ford, Juan Vallejo
Naturalcooling Ltd.

Julian Marsh, Suzy Hunt
Marsh Grochowski Architects



NGHS Theatre: stage and auditorium 3D view.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Sustainable low carbon theatre and auditorium design can challenge the ingenuity of design teams. While the potential benefits of natural ventilation may be acknowledged, the task of designing a robust natural ventilation system while simultaneously meeting sometimes complex acoustic, structural and environmental requirements can be demanding. This may explain why, in spite of a long and rich historical tradition of naturally ventilated theatre and auditorium design, there are only a limited number of contemporary examples. However, the benefits can be significant in terms of reducing costs (carbon emissions) and maintenance costs, without compromising performance. Embedding a natural ventilation strategy within a design requires the commitment and engagement of the architect (and the client), as it is likely to have a significant influence on the geometry and layout of the building. After briefly reviewing the historical tradition and contemporary examples, this paper focuses on the process of assessing feasibility and integrating a natural ventilation strategy within the design of a theatre auditorium. Performance prediction at different stages is also described, providing confidence to the design team and client in proceeding with natural ventilation. This will hopefully be of benefit to architects and engineers considering how to design and deliver naturally ventilated buildings. The paper also suggests that such an approach may be applicable to other building types, identifying the wider social, economic and environmental benefits of adopting non-mechanical solutions to the ventilation and cooling of non-domestic buildings.

KEYWORDS: *Theatre design, natural ventilation, ventilation strategies, performance analysis.*

SWISSWOODHOUSE, INNOVATIVE EXPERIMENTATION IN SUSTAINABLE MODULAR HOUSING : FROM INTERDISCIPLINARY RESEARCH TO POST-OCCUPANCY MONITORING

Rey Emmanuel[1, 2], Graf Stefan[1]
[1]Bauart Architectes et Urbanistes SA, Bern / Neuchâtel / Zurich, Switzerland
[2]Laboratory of Architecture and Sustainable Technologies (LAST), Ecole polytechnique fédérale de Lausanne (EPFL), Lausanne, Switzerland

View of the pilot project built in Nebikon, Switzerland

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The Swisswoodhouse concept is the outcome of a number of studies on issues related to urban densification, structural changes in households, housing adaptability and the environmental challenges of sustainable construction. The building design is more specifically based on the aggregation of prefabricated 22 m2 wooden modules that can be adapted to provide a wide variety of types and functions. At the technical level, priority has been given to energy issues in order to satisfy the requirements of the vision of the "2000-Watt society". Following an interdisciplinary research phase, a first building with 18 apartments was completed as an experimental prototype near the railway station at Nebikon, Switzerland. This first achievement provided an opportunity to test the overall results of the parameters developed within the research framework. At the construction level, the experiment successfully tested the prefabrication and on-site assembly processes as a whole. In terms of energy, post-occupancy monitoring was set up to provide the first indicative figures on the performances of the building.

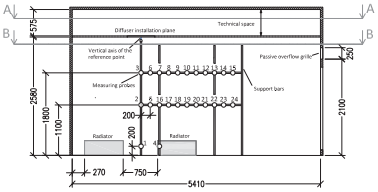
KEYWORDS: *SUSTAINABLE ARCHITECTURE, MODULAR HOUSING, INTEGRATED DESIGN, 2000-WATT SOCIETY*

STUDY ON AIR SUPPLY DIFFUSER PROTOTYPES TO MAINTAIN LOW AIR VELOCITY AND DRAFT RATE IN HUMAN'S OCCUPANCY ZONE

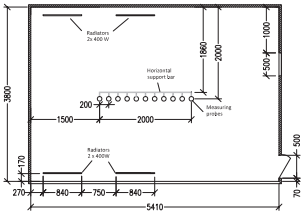
Aleksejs Prozuments, Anatolijs Borodinecs

Riga technical University, Latvia

Cross section
of a test chamber



Plan view of a test chamber
Section B-B



WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

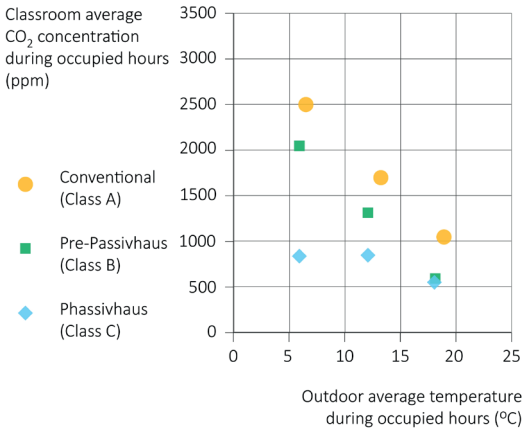
Good indoor air quality requires sufficient amount of air to be supplied and well distributed within a space. The velocity of supplied air should be kept at a level which ensures that the mixing is effective, but at the same time ensures that the air velocity has fallen to the required level by the time it reaches the occupied zone in order to prevent occupants from being exposed to local discomfort caused by draft. The general value which characterizes the human comfort level is draft rate. ASHRAE 55:2004 defines DR value as "predicted percentage of people dissatisfied due to annoyance by draft". ASHRAE stipulates in Standard 55:2004 that DR must be <20% and air velocity must be <0.2m/s to meet the requirements for B category single-office room. Four prototypes of air supply diffusers (with plain, perforated, swirl and nozzle faceplate) were tested to determine the air velocity and draft level at increasing flowrate. The tests were performed at certified aerodynamics laboratory in a specially designed test chamber which represented a single office room. 24 measuring probes were installed in the test chamber to measure air velocity and air temperature. The tests were performed at cool air supply conditions when the risk of draft is the greatest. The results of the study showed that all four tested diffuser prototypes provide different indoor comfort conditions in the human's occupancy zone, that are strongly dependent on the flowrate range. Plain and nozzle diffusers achieved Coanda effect relatively quickly and performed better with regards to air velocity and draft rate criteria compared to perforated and swirl diffusers. At higher flowrate range perforated diffuser performed quite adequately, since the air circulation is stabilized and is no longer directed straight downwards. Primary purpose of swirl diffusers is to generate a swirl effect therefore swirl prototype created quite significant turbulence at both lower and higher flowrate, nevertheless keeping DR and velocity values below the critical level.

KEYWORDS: *VENTILATION, INDOOR AIR QUALITY, SUPPLY DIFFUSERS, DRAFT RATE.*

SEASONAL VARIATION OF INDOOR AIR QUALITY IN CLASSROOMS OF A 1970s CONVENTIONAL, A PRE-PASSIVHAUS AND A PASSIVHAUS PRIMARY SCHOOL BUILDINGS IN THE UK

Chrysoula Thoua, Mark Lumley
Architype

Dr Azadeh Montazami, Prof Mark Gaterell
Coventry University



Average CO_2 concentration plotted against average outdoor temperature for the occupied hours, for 3 classrooms

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A number of studies argued that poor indoor air quality (IAQ) in primary school classrooms can have a measurable impact on the concentration and learning ability of pupils (Bakó-Biró et al, 2012). As children's academic performance is seen to decrease in deprived areas in the UK, the classroom environment needs to be assessed with a focus on its impact on pupils' learning. The conflict between winter thermal comfort and natural ventilation has been investigated in a number of studies and, while it is understood that the risk of poor IAQ in the classroom is higher in winter, more often than not there is not enough evidence to support a correlation between indoor temperatures and IAQ.

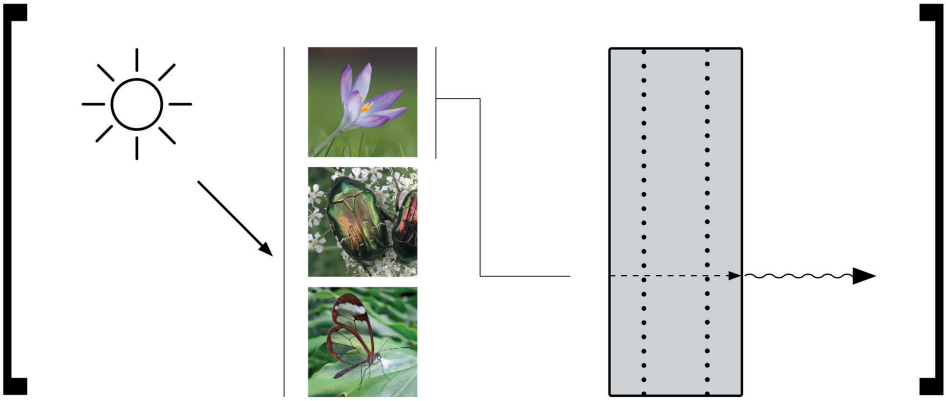
This study uses monitoring data to investigate if classrooms in a naturally ventilated and poorly insulated building are more prone to a negative correlation between mean outdoor temperature and indoor CO2 levels, compared to a naturally ventilated super-insulated and a Passivhaus building. Findings from this study, suggested that in order to eliminate the risk of a negative effect on children's health and performance due to poor IAQ in colder climates, we need to invest in well-insulated airtight Passivhaus schools equipped with mechanical ventilation with heat recovery, and CO2 dictated supply rates. Further research shall use thermal dynamic simulation and CFD analysis for classrooms in different building types in the UK, to reveal the ideal strategy and design.

KEYWORDS: *CLASSROOM, INDOOR AIR QUALITY, PASSIVHAUS PRIMARY SCHOOLS*

ANALYSIS OF POTENTIAL BIOMIMETIC APPLICATIONS OF SKIN ANALOGIES ON THE BUILDING ENVELOPE

Leopoldo Saavedra, M.Sc., Prof. Dr.-Ing. Werner Lang

Technical University Munich



tension field between climate parameters (solar radiation) and the requirements of users including possible biological information to be applied on the building envelope

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

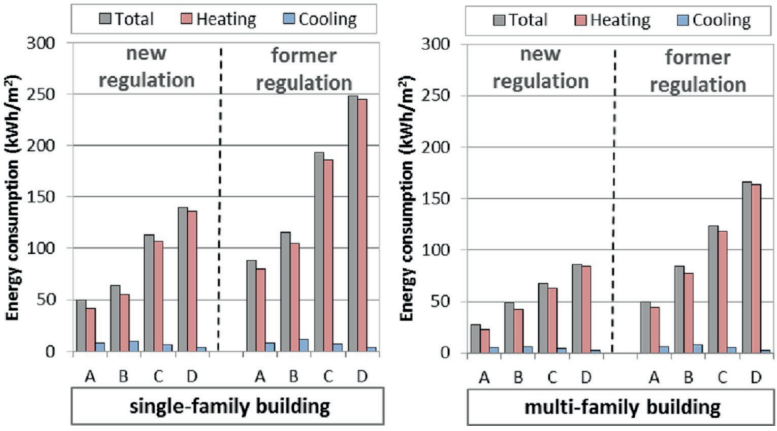
The transfer of information between nature and technology and associated potential technological applications offer a wide range of possibilities for both systemic and energy-related optimization of buildings. The building envelope plays a crucial role in the generation and preservation of a controlled indoor climate. This approach understands the building envelope as a system able to perform various tasks beyond the single addition of separated functional components. The study focuses on detailed research of the functional properties of the building envelope. Particular emphasis is placed on the analysis of the potential of biomimetics to optimize and expand the functional spectrum of the building envelope. The aim is to investigate the capacity of future buildings to operate in a self-regulating, adaptive and symbiotic way, mediating between the outdoor conditions and the intended indoor climate. A taxonomic analysis of the building envelope is employed to select 15 functions relevant to energy efficiency and material from approximately 30 identified functions. Four functional groups are being examined in detail: dynamic air, daylight, thermal energy and humidity control. Building upon this functional classification, biological phenomena are assigned on a selective basis. The assignment of biological phenomena is carried out using a specially designed and building specific searching procedure based on the taxonomic analysis of the building envelope. The main focus is on the study of biological skins and envelopes and their potential uses and applications on the field of the building envelope. Based on the analysis and comparison of the functional properties of biological systems, potential applications of selected building envelopes in the building sector are presented.

KEYWORDS: *BIO-INSPIRED; BUILDING ENVELOPE; ADAPTIVITY; BIOMIMICRY*

EVALUATING THE IMPACT OF THE NEW ENERGY REGULATION ON THE ENERGY, ENVIRONMENTAL AND ECONOMICAL PERFORMANCE OF GREEK BUILDINGS

Katerina Tsikaloudaki, Konstantinos Laskos
Aristotle University of Thessaloniki

Athina Gaglia, Evangelos Dialinas
National Technical Univ. of Athens



The energy performance of a typical single- and multi-family building when studied with regard to the requirements of the former and the current energy regulation.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

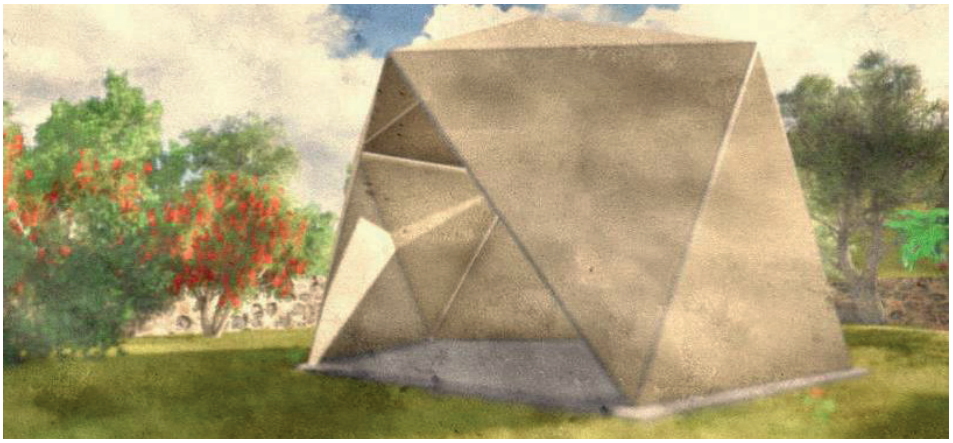
This paper attempts to quantify the changes in terms of energy, environmental and economic parameters brought by the introduction of the new energy performance regulation in Greece. It focuses on the performance requirements of the building elements foreseen by the former and the current regulation for residential buildings that are representative of the Greek urban regions. More specifically, the provisions for the thermal transmittance of the building elements foreseen in the former and the current energy performance regulation are applied in a typical single- and a multi-family building, which is located on different climatic zones. Due to the different levels of thermal insulation calculated in line with the two regulations, the differentiation on the energy needs, the environmental impacts as well as the economic burden from the use of advanced materials and the economic benefit from the energy savings is specified. This work not only highlights the impact of the new regulation on the overall building performance for two different building types located in, but also provides indications for the effectiveness of forthcoming stricter measures, which are expected in the light of achieving the 20-20-20 EU objectives.

KEYWORDS: *THERMAL INSULATION; ENERGY PERFORMANCE; ENVIRONMENTAL PERFORMANCE; RESIDENTIAL BUILDINGS*

MODULAR RURAL HOUSING OF LOW COST, LOW ENVIRONMENTAL IMPACT AND SELF-BUILDABLE MADE OF BAMBOO WATTLE & DAUB & DAUB IN COLIMA, MEXICO

Miguel Elizondo-Mata, Carlos J. Esparza-López, Jorge A. Ojeda-Sánchez, Adolfo Gómez-Amador, Marcos González-Trevizo, Juan R. González de Loza

Universidad de Colima



Schematic model of prototype

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper focuses on the development of a modular construction system of rural low-cost housing and low environmental impact, using mud and bamboo. The system applied traditionally is known as "wattle and daub". This system involves the use of a vegetal warp coated with a mixture of soil stabilized with lime and rice straw. This traditional construction technique has been used since ancient times in architecture without architects, mainly in American continent rural areas with slight variations from one region to another. It is intended that the final cost of the basic module is around $80 USD a square meter including facilities and finishes. Rigidity is achieved through a geodesic dome structure V1 frequency. The combination of the dome and the wattle & daub confers advantages such as seismic resistance, durability, ease of construction, optimization of natural resources and the use of local materials. The preliminary design was a basic module of 15 square meters in order to permit the gradual growth of the house. Original purpose was to make hygrothermal performance inside the prototype. However, prototype is not completed in scheduled time due to delay of approval on environmental impact for the use of native bamboo (Otatea acuminata ssp. Aztecorum) by the federal environmental authority. Instead, it was determined the monitoring with specimens of 0.25 x 0.25 m. x 0.11 m. This allowed the analysis of three different binder samples combinations: lime/sand, earth/straw and cement/sand. Recording equipment used was HOBO onsetcomp U12-012 for temperature and RH. Also thermal conductivities of the materials were determined using a conductivimeter KD2PRO. Measurement data mentioned above are intended to describe the thermal performance of materials in different configurations wattle & daub and set up an approximation of a mathematical model of the global heat transfer coefficient of wattle & daub in a stationary state.

KEYWORDS: *Low-cost housing, wattle & daub construction system, bamboo wattle & daub*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Improving perFORMance

2nd Parallel Session

DAY 2

10:30 – 12:30

CHAIRMEN

Francesca De Filippi ..... Table 7
Andrea Fornasiero ..... Table 8

MEXICAN BAMBOO BUILDING SYSTEMS FOR LOW IN-COME SITES AND ITS THERMAL CHARACTERISTICS

Guillermo Terrés, Manuel D. Gordon, Israel Tovar

UAM-A Mexico City

: Bamboo housing in different low in-come sites of Mexico: 1. Puebla; 2 & 3. Veracruz. (http://www.bambumex.org/paginas/fotogaleria3.htm May 2015)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

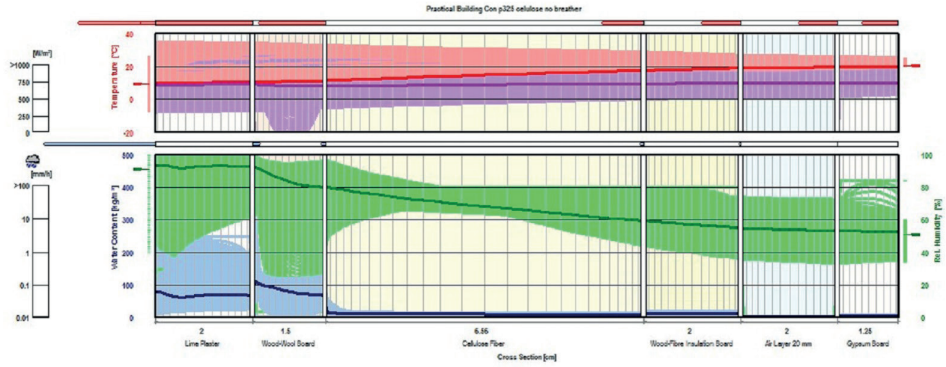
The Architectural (R) Solution in this study is the application of a building system in areas of Mexico with high poverty and where the efficient use of alternative systems for housing is necessary. Bamboo building systems achieve economic performance, seismic resistance, quick execution, high durability, interior comfort and low energy consumptions. Most researches about this type of buildings are focused on their structural characteristics. Thermal behavior characteristics have been analyzed in few study cases. More studies about this building systems based on vernacular innovations will result in an increase of their use and correct applications in Mexico and other countries. This research aims to study thermal characteristics of conductivity, conductance and thermal transmission, for four arrangements of bamboo based construction systems used in the Valley of Mexico. The arrangements were analyzed in real scale prototypes simulating as accurate as possible real physical conditions in which are use. The criteria for selecting these building systems were based in points such as follow. The application of the systems is most frequent in areas of low in-come and poverty, no specialized tools or materials are required, the building techniques are easy to learn and anyone can apply them, most of the work is man powered so the energy demand is low through the entire building process. Through a series of test performed in the laboratories of UAM-A, coefficients of the thermal behavior of the systems were obtained, such as density, specific heat and thermal conductivity. The coefficients obtained by this investigation were used for numerical simulations in a real climate to compare the systems with a traditional used building system in Mexico. Simulating the thermal response of buildings before constructed allows architects to put to the test their designs and bioclimatic strategies, in order to achieve maximum comfort for their future occupants.

KEYWORDS:*Bamboo architecture, thermal characteristics, energy efficiency, low in-come housing, sustainable building.*

INTERSTITIAL HYGROTHERMAL CONDITIONS OF LOW CARBON RETROFITTING DETAILS FOR HISTORIC TIMBER-FRAMED BUILDINGS IN UK

Christopher Whitman, Oriel Prizeman
Cardiff University

Pete Walker
University of Bath



WUFI Pro5 simulation of English Heritage replacement infill detail.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Heritage buildings have often been considered off-limits when considering energy refurbishment projects, however rising energy prices and stricter legislation for public buildings mean that they can no longer be ignored (Todorović, 2012). In the case of historic properties refurbishment is a complex issue, involving aesthetic considerations in addition to technical issues (English Heritage, 2012). The hygrothermal behaviour of wall build-ups of traditional materials must also be fully understood in order to avoid problems of interstitial moisture, long term decay and overheating. Research in this area to date has focused on solid-walled masonry construction (Gandhi, Jiang , & Tweed, 2012; Mohammadpourkarbasi & Sharples, 2013; Scott & Rye, 2014) however little work has been conducted on historic timber-framed construction, the subject of the research presented in this paper. Whilst representing only a small percentage of the UK pre-1919 housing stock (approximately 66,000 in England (Nicol, Beer, & Scott, 2014); 1,200 in Wales and almost non-existent in Scotland (Naismith, 1985) and Northern Ireland (Gailey, 1984)), many historic timber-framed buildings have stood for hundreds of years and form an important element of UK heritage. Inappropriate introduction of thermal insulation can cause unintentional negative impacts, including increased moisture content and interstitial condensation leading to the deterioration of the built fabric. Using WUFI Pro5 transient heat and moisture simulation software, the interstitial temperature, humidity and moisture conditions within traditional and retrofitted wall build-ups have been simulated. This paper presents the results of these simulations which would initially suggest that current proposed retrofit details do not pose a serious threat to timber-framed buildings. Further simulation, experimental and building monitoring, is however required and this is planned as part of this on-going research programme.

KEYWORDS: *Timber-framed, interstitial, hygrothermal, retrofit, simulation, UK*

SUSTAINABLE SCHOOLS AND MOVABLE HEALTHCARE FACILITIES AS ANSWER TO SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES IN D.R. CONGO

Monica Rossi - HTWK Leipzig, Germany
Maura Carassai - UNICAM, Italy
Alessio Battistella- Arcò società coperativa
Gabriella De Angelis - UPC, Spain

Design application in Kamuesha, Congo: masterplan, front and 3D view.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Primary education and healthcare are a pressing issue in many African regions. This research - characterized by an application in Western Kasai, Democratic Republic of Congo - starts from a thorough analysis of the social, economic, "constructive" and environmental conditions of this region with the intent to provide concrete answers to real problems. The main objectives of this work are: guarantee not only primary education, but also training of local health workers; stimulate local economy through the use of local workers and technologies, maintain the local culture and to simplify the buildings' maintenance; provide healthcare even in small villages far away and poorly connected to hospitals and get indoor and outdoor good comfort spaces using easy passive environmental control strategies. In the case study of the village Kamuesha (fig. 1), these objectives have been achieved by: 1) redevelopment of existing school buildings; 2) design of a small clinic that houses surgeries, operation rooms, an analysis' laboratory and rooms for short hospital stays; 3) design of a training school for nurses; 4) development of two types of movable healthcare facilities. The first "container clinic" has a healthy and sterile environment appropriate to carry out small operations. The second one is smaller and is used as ambulatory and centre of vaccination. Both can be used also without a connection to the electricity network and are adaptable to varying site conditions; 5) design of covered outdoor collective spaces according to the African social traditions.
In conclusion this project intends to give a joint response to the problems of primary education and healthcare in Western Kasai. The proposed design solution is also the "testing ground" for a design approach repeatable in similar situations.

KEYWORDS: *DEVELOPING COUNTRIES, D.R. CONGO, SCHOOLS, HEALTHCARE FACILITIES*

ENVIRONMENTAL ATTRIBUTES IN RETROFITTING OF HERITAGE BUILDINGS PEREIRA PALACE SANTIAGO, CHILE

Alberto Moletto MSc, José Antonio Espinoza MArch

Finis Terrae University

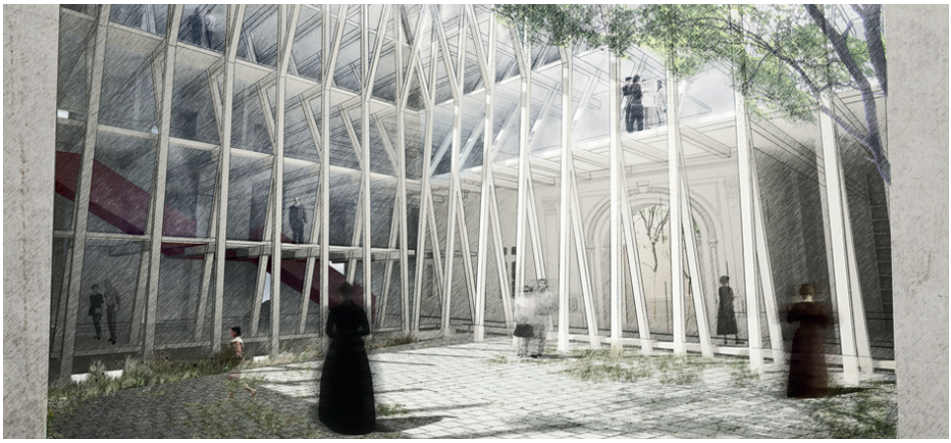


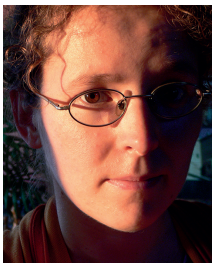
image of inner courtyard

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The Ministry of Culture of Chile launched an international architectural competition aiming to house the new headquarters of the National Archives for Libraries and Museums. The original building corresponds to a highly deteriorated heritage building built in the 1870s (Pereira Palace), in Santiago de Chile. This competition considered the retrofitting of the building, and addition of office space. This paper explores the outcomes of a sustainability consultancy, which was part of the winning scheme. The results where highly influenced by two main conditions: The existing building envelope composed of a brick wall with 70 cm thickness with a transmittance value of 0,45 W/m2K which leads to a high level of thermal mass; and the urban surroundings that block an important part of the direct radiation in the building. The first place of this competition was awarded to (name of the architects).
In Chile, heritage buildings are subjected to strict regulations including spatial restrictions in the existing plot. The consultancy process was strongly focused on the identification of the main environmental features of the building and the proposal of a particular building envelope for the addition areas. In addition to that, the detailed design for the glazed interior corridor, and the natural ventilation in semi open spaces was also carefully studied.

KEYWORDS: *Heritage, Retrofitting, Chile.*



USING SCIENCE, SENSES AND EXPERIMENTATION TO TEACH THE IMPORTANCE OF THE CONSTRUCTION CYCLE IN UNIVERSITIES: THE AMÀCO PEDAGOGICAL PROJECT

Laetitia Fontaine – CRAterre Laboratory / AE&CC Unit Research / ENSA Grenoble
Marion M Bisiaux, Romain Anger, Hugo Houben, Basile Cloquet
amàco - atelier matières à construire / Les Grands Ateliers

Students during the exercise of the Sand Tower, a 3 meters-high tower, with load bearing walls only 4 centimetres thick build with nothing else but sand, water and fibres.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The construction cycle implies the use, recycling or disposal of local resources and thus the socio-economic and technical habits of a territory in terms of building cultures. Therefore, this cycle can be taken as the basis from which other sustainability concepts in the field of construction can originate from. However, the construction cycle, that includes all the steps of the construction process, from the material extraction, the implementation of the building in a given territory, to the demolition and the treatment of the wastes, is rarely considered in its entirety. Since 2012, the French governmental project "amàco" ("atelier matières à construire"), designs pedagogical methods and contents based on the use of this notion of the construction cycle for architecture and engineering schools teachings. For that purpose, amàco utilizes matter science to help the students understand the behaviour of any raw matter that they can find near or on the construction site. The teaching method is based on simple scientific experiments on five categories of matter science: granular matter, fibrous matter, binding matter, soft matter and liquid matter. From these five categories, the physical and chemical properties of any construction materials such as wood, concrete, earth or straw can be explained. On the other hand, the project tries to give maximum emphasis to the links between physicochemical properties of raw matter and its aesthetics and sensory aspects. With this scientific and sensorial background, the students are invited to participate in experimental and creative workshops and real scale construction exercises. These exercises aim at re-creating a link between students and raw matter and the emotional background that can be associated with social habits of local building cultures. Finally, it aims at facilitating the transfer of knowledge and innovating techniques between new and vernacular construction techniques, back and forth from universities to professionals.

KEYWORDS: *MATTER SCIENCE, RAW MATTER, CONSTRUCTION CYCLE, LEARNING BY DOING, PEDAGOGY, EXPERIMENTATION, ARCHITECTURE, SUSTAINABLE, VERNACULAR*

THE RESILIENCE FOR ZARI CRAFTSMEN OF BHOPAL, M.P, INDIA

Shikha Patidar
VINYAS Bhopal

Brishbhanlali Raghuwanshi, Shweta Saxena
SPA Bhopal

Women weaver at Maheshwar, M.P., India

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

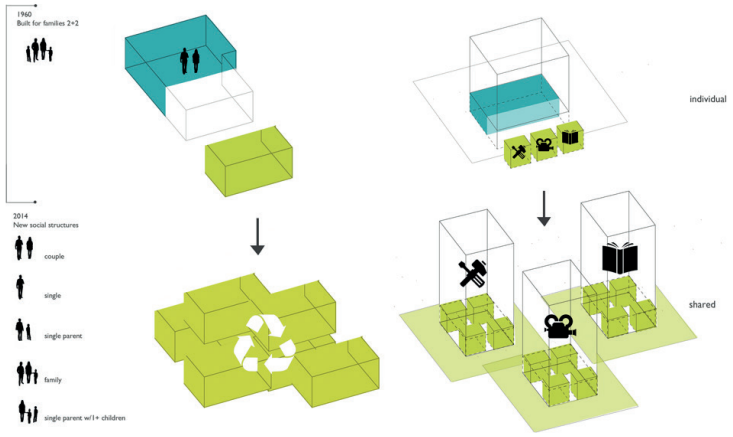
India has a rich tradition of art and craft. The Indian craftsmen are keeping the traditions alive by transferring the knowledge and skills from generations to generation. The vernacular settlements have evolved as per their lifestyle and work culture. Madhya Pradesh is one such state located in central India, some of its famous crafts are textiles, zari work and pottery. Bhopal is the capital of Madhya Pradesh. It is known for its zari craft but today its existence is in threat. In urban areas some of these crafts are neglected and unrecognized thus are vanishing from the society, the traditional zari craft of Bhopal is one of them. There is an urgent need for the revival of this craft and survival of the craftsmen. The objective of the paper is to provide resilience to zari craftsmen of Bhopal. The methodology adopted is to document the lifestyle, work culture and trade of weavers at Maheshwar. Maheshwar is a city in Madhya Pradesh, known for its textiles in India and abroad, this craft is sustaining for ages. The dwellings of zari craftsmen of Bhopal are documented and studied the role of Maheshwar and Bhopal in the formation of dwelling and evolution of settlement. Both the craft centres are analysed on social, environmental, economical and architectural aspects. The learnings from Maheshwar can be adopted in the planning for zari carftsmen at Bhopal. The traditional knowledge and modern technology should be integrated to meet the contemporary need. There is a need for an innovative and creative approach towards the revivial of the craft. The paper concludes that settlements should be planned as per the work culture and life style of a specific craft, only than the vanishing craft will survive in the society.

KEYWORDS: *ZARI, CRAFTSMEN, WORK CULTURE, VERNACULAR SETTLEMENT, RESILIENCE, SELF-SUSTAINABLE*

HYPERAUBING, MORE WITH LESS: BEYOND EFFICIENCY

Daniele Santucci

TU München



Transformation

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Climate change, population growth and resource shortages are the most crucial issues of our time. Natural disasters, migration flows and waste accumulation are the most visible effects. While the population is decreasing in European countries, the global trend is a rapid growth, especially in cities. In this context, availability, distribution and an adequate management of resources are the fundamental issues we have to deal with. Saving resources means achieving a more effective use and a more equal distribution. While in the last decades energy production has been basing on peak demand, the use of renewables requires adaptation to the available sources, in terms of local as well as temporal availability. Architecture has the responsibility to understand these challenges and to adapt them to the human needs by synthesizing information and transforming it into physical entities. Today, the data that is continuously recorded and shared through digital media can be employed to reach these aims. The amount of information at our disposal is enormous and its correct use is fundamental to creating quality when and conserving our built environment. Architects are asked to improve its quality through design and planning approaches, which create strong synergies with the context and the available resources. Resource optimization and distribution is the main challenge for our future to assure more quality for all with less expenditure of energy: is this not the great challenge?

KEYWORDS: *Quality, resources, digital era, adaptation, synergies*

THE GLAZING OF BALCONIES AS A RETROFITTING SOLUTION FOR REDUCING THE HEATING LOAD OF THE ADJACENT ROOM IN ATHENS

Leonidas Tsichritzis, Simos Yannas

Architectural Association School of Architecture

Perspective view of the social housing scheme (Source: Bing maps).

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

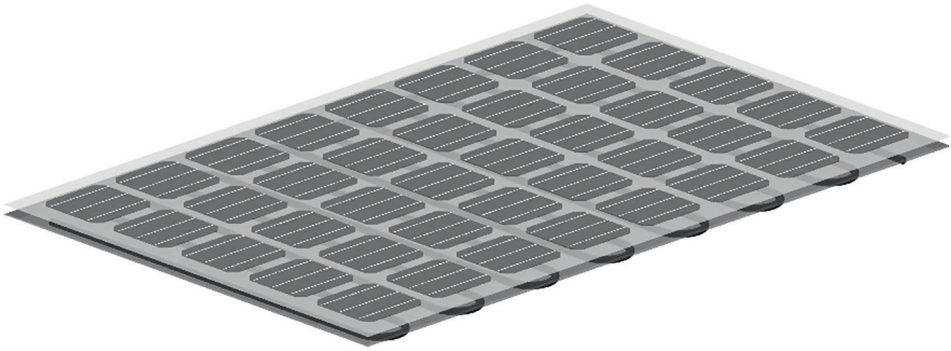
Research Summary

The glazing of balconies in residential buildings has become a frequent practice in several European cities as a low cost option for expanding habitable space making use of a feature that has lost its original functionality and architectural expression. Although the climate of Athens, Greece, is characterised by a mild winter with high incident solar radiation, the city's aging building stock suffers from poor environmental conditions and high energy consumption for space heating. The paper assesses the heating energy saving potential of retrofitting glazing to balconies of multi-storey residential buildings. Glazed balconies with good solar access can preserve indoor thermal comfort conditions for longer periods in winter, while those balconies that are poorly oriented or overshadowed can still contribute to space heating loads of adjacent rooms by thermal buffering.

KEYWORDS: *Retrofitting Residential Buildings, Environmental Performance, Heating Energy Demand, Thermal Comfort*

HOW TO INTEGRATE HYBRID COLLECTORS IN BUILDINGS TO OPTIMISE PERFORMANCE

Jan Cremers - Stuttgart University of Applied Science
Centre for Integral Architecture
Xavier Jobard - Centre for Sustainable Energy Technology
Nansi Palla, Christiane Schoch - Centre for Integral Architecture



Schematic Diagram of a PVT Collector

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

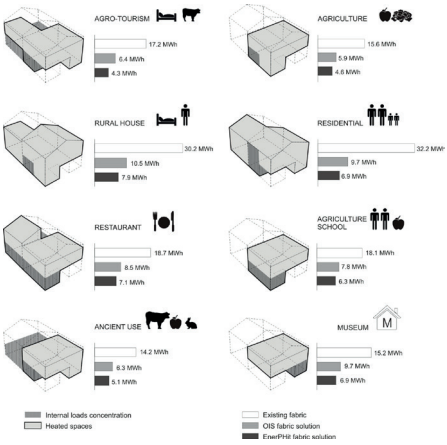
It is commonly acknowledged that the integration of renewable energy sources is essential for sustainable buildings. PVT collectors (photovoltaic and solar thermal in one module) can be integrated into roofs and facades of buildings to cover a significant part of heating, cooling and electricity demand. This makes PVT collectors quite efficient because more than one energy form can be provided on valuable envelope surfaces. This fact opens up a new perspective for using renewable energy sources for buildings and should be discussed to provide planners and architects practical knowledge and a guideline to apply this technique during the conceptual design of building integrated PVT collectors. The aim of PVT technology is to use the whole range of potential solar irradiation during the day and the radiative potential of the same envelope surface at night to provide local renewable energy. With this synergy, a cost-effective and efficient technology can be provided. When PVT collectors are designed as low-tech and therefore, cost-effective, their application becomes even more attractive in terms of investment costs and material use minimization. But the performance of a PVT collector strongly depends on its integration into the building envelope and engineering system. This paper examines among these factors, the role of the building integration and the orientation in the optimization of PVT collector integration. The emerging technology of PVT collectors has been researched at the University for some years. New prototypes of PVT collectors with different thermal absorbers and PV modules have been developed and tested under dynamic outdoor conditions at the test stand of the University. Some measurement results are also provided in this paper.

KEYWORDS: *Hybrid Photovoltaic-Thermal Collectors, Building Integrated PVT, Radiative Cooling*

USER SCENARIOS IN BALANCED RETROFIT: THE CASE OF BASERRIS

Ugaitz Gaztelu
University of the Basque Country UPV/EHU

Emanuele Naboni, Ola Wedebrunn
Institute of Architectural Technology, The Royal Danish Academy of Fine Arts, School of Architecture



WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The energy efficient adaptation of a historic building to future user scenarios is discussed with the case of baserris, the typical Basque farm. Following the industrial revolution several baserris were abandoned (fig. 1) as the inhabitants moved to the cities. Today, there is a necessity in repopulating the baserris with a series of contemporary users' scenarios. The few examples of retrofitted baserris is based on the simplistic approach proposed by regulations, or standards such as the EnerPHit. The paper describes the hypothesis of an energy and culture balanced retrofit that sustains the adaptation to contemporary uses based on the understanding of a baserri thermodynamic behavior.

The baserris as conceived in the XVth century and onwards are an example of an energy self-sufficient thermodynamic system that capitalize internal heat loads generated by agricultural production systems. Energy stored by the thermal mass is a critical aspect of their function which is undermined by according to code interventions. This paper explores a balanced retrofit that complements future user scenarios' thermodynamic implications and fabric interventions.

KEYWORDS: *Energy Retrofit, User Scenarios, Built Heritage*

A BRAZILIAN "VENICE" IN THE AMAZON. ISLAND OF AFUA: DESIGN OF NEW SUSTAINABLE PUBLIC SPACES

Jose Medeiros
UnB - FAU e UNIFAP - CAU
Jacy Soares Correa Neto
UNIFAP
Marta Adriana Bustos Romero
UNB

Aerial view of Afua town. Source: www.skyscrapercity.com.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Locally known as the "Venice of Marajo Island", the Island of Afua is located in the mouth of the Amazon River, in the state of Para, North of Brazil. The structure of the city of Afua has streets made of wood boards on stilts, in a lowland area circumvented by several channels. The tide of the Amazon River floods all the ground every day and only pedestrians and bicycles are allowed in the city. The main goal of this research was to obtain new data that contribute to the social, urban and scientific development of Afua as well as others small Amazonian cities. The method was dialectical and research had quantitative and qualitative character through the use of questionnaires and references on the subject and on-site survey (land use, photographic records and data collection). Based on the presented theories, there were performed physical, urban and socio-territorial analyses of the town's riverfront, in order to get an overview regarding the territorialisation process. It was elaborated an urban design proposal with emphasis on the representation of the diversity of activities on the riverfront, by considering the identity and local context, the economy and the culture spaces, which are formed as strategic factors of social and economic development of the community. Using principles of ecological sustainability were project piers, parking for boats, local food markets and a museum, all interconnected with pedestrians and bicycles access, with low-cost materials and re-insertion of native vegetation.

KEYWORDS: *Brazil. Amazon. Island of Afua. Public spaces. Riverfront.*

ACHEIVING COMFORT IN SUBTROPICAL CLIMATES: BUILDING A MICROCLIMATE IN THE GUANGZHOU SCIENCE MUSEUM

Jeewon Paek, Moritz Fleischmann
HENN GmbH

Felix Thumm
Transsolar

Facade with evaporative cooling pipes and shading

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper presents a collaboration between HENN architects and climate engineering firm, Transsolar for a competition entry in Guangzhou, China. The Guangzhou Science Museum is designed to provide maximum user comfort and a memorable museum experience while minimizing impact on the environment. The museum also strives to provide comfortable spaces surrounding the building, at grade and on balconies. To mitigate the local subtropical climatic conditions of Guangzhou, China, the project extends the period of outdoor comfort levels through building a microclimate. Evaporative cooling pipes are seamlessly integrated and woven into the facade sun shade design of the building to reduce temperatures surrounding the museum. In the urban scale, sunken plazas opening to the underground level contain the cooled air with open water features, standalone shading structures, and tall vegetation. The exterior surfaces of the building lamellas are coated with a titanium dioxide layer, which contribute to purifying pollutants from the air at the micro scale. Museum visitors can further enjoy shaded, cooled balconies which perform as transition spaces between the exterior and interior environment.

KEYWORDS: *Evaporative Cooling, Microclimate, Subtropical, Adaptive Comfort*

DAYLIGHTING ASSESSMENT AND OPTIMIZATION OF MULTI-ZONE ELECTROCHROMIC GLASS WINDOW INTEGRATED WITH LIGHT SHELF

Ahoo Malekafzali, Jianxin Hu

North Carolina State University

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

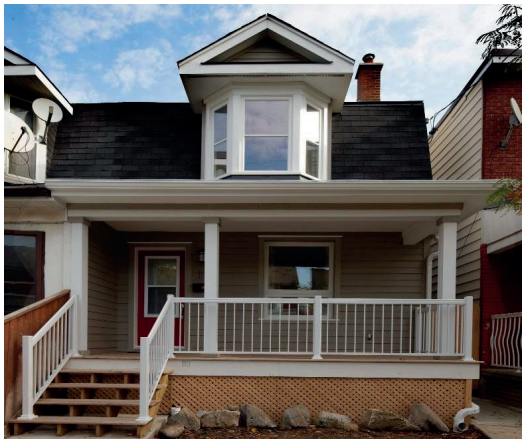
Electrochromic (EC) glass, one of the most advanced products in energy efficient window technology, is designed to transform window from an energy liability to an energy source for the nation's building stock [1]. EC windows vary their visual and thermal properties by electric field. They preserve outside views while controlling transmitted light and solar heat gains. Although EC windows can provide considerable energy savings and relatively stable light levels, they can be improved to block direct sunlight and to balance light distribution more effectively under certain solar and sky conditions. This research focuses on the optimization of EC windows by integrating the glazing with interior light shelf, a horizontal light-reflecting device installed approximately 8 feet above the floor. The light shelf divides the glazing into two zones, daylight glazing (the zone about the light shelf) and view glazing (the zone below). The light shelf potentially provides protection from direct sunlight and projects daylight into deeper areas of the space. EC glass with different tinting control algorithms based on interior light sensor can be installed in the daylight and view glazing areas to dynamically control the visible light transmittance of both zones according to the exterior light intensity and solar angle incident on the window. Physical experiment is conducted as the primary method for assessing daylighting performance. Two pieces of SAGE Electrochromic glass are installed in a near full-scale rotatable test-cell at NCSU Daylighting Lab equipped with 16 photometer sensors for daylight level measurements. The experimental results show that the proposed multiple-zone Electrochromic window system integrated with light-shelf can significantly improve the daylighting performance and visual comfort of the daylit space.

KEYWORDS: *Electrochromic Window, Control System, Visible Light Transmittance, Light Shelf*

AN INNOVATIVE BUILDING ENCLOSURE RETROFIT FOR AN EXISTING SOLID MASONRY DOUBLE WYTHE BRICK HOME IN A COLD CLIMATE

P. Christopher Timusk, Steffanie Adams

George Brown College



Completed Retrofit Project: 111 Russett Avenue

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

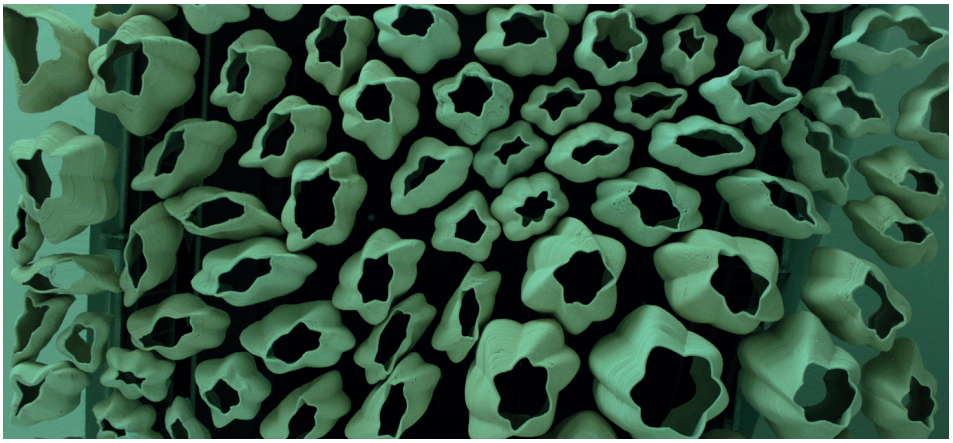
Much of the housing stock of our larger cities consists of old buildings, many of which were built around the beginning of the 20th century and constitute our least energy efficient buildings. They are either totally un-insulated or poorly insulated, resulting in large volumes of air leakage. It is clear that increasing the energy efficiency of buildings is vital in ensuring energy security while minimizing environmental damage for future generations. 111 Russett Avenue is a double-wythe solid masonry brick building, a building type very common to Toronto and other North American cities. In partnership with MyHaven GreenVision Homes, the Russet Avenue Project focuses on the development of a new and innovative "green" re-cladding system that can be applied to old or "vintage" buildings. The following research questions will be answered; "What are the best technologies (materials and methods) for achieving energy efficiency within the constraints associated with vintage buildings?", "What is the cost/benefit of retrofitting vintage building?" and "To what extent can the retrofit of vintage building and "green" co-exist?"

KEYWORDS: *Retrofit, Energy Efficiency, Building Enclosure, "Green" Recladding system, Revitalization*

ADVANCED CERAMICS 3D PRINTING TECHNOLOGIES FOR ECOLOGICAL ARCHITECTURE

Paolo Cascone
COdesignLab

Imma Polito, Andrea Giglio, Giuliano Galluccio, Elena Ciancio, Flavio Galdi
Urban FabLab



traditional manufacturing and 3D printing with clay (Marrakech 2014), courtesy of COdesignLab

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The paper will focus on the role of open source technologies as potential drivers in contemporary city changes using digital fabrication and self-production processes for building ecological dwellings. Starting from the Mostafavi's concept of ecological urbanism, this research aims to find a new way to integrate the traditional building skills to the opportunities given by the open source digital fabrication culture, repurposing the earth made and woodless vernacular architecture to the contemporary innovative construction techniques. In this sense, the paper will describe the first prototype of structural skin that is conceived to explore the possibilities of using natural ceramics (desert clay of Morocco) for design and 3D print structural components involving local craftsmen. Moreover, the paper will focus on a design strategy through a bottom up approach, relying on the implicit self-adaptation features of clay and ceramics, in order to produce a catalogue of differentiated architectural configurations of performative "polybricks". The outcome of this first step of the Advanced Ceramics research is to deal with the environmental, social and economic constraints to build the first performative skin prototype in Morocco. The next step will be to improve the participatory process and test a bigger 3D printer for structural components in order to develop a low-cost scale 1 to 1 dwelling for hot climate areas.

KEYWORDS: *ECOLOGICAL URBANISM, DIGITAL FABRICATION, CERAMIC, 3D PRINTING, PERFORMATIVE ARCHITECTURE, COMPUTATIONAL DESIGN*

THE PERFORMANCE OF NATURAL VENTILATION IN A DANCE STUDIO - LESSONS FROM TRACER GAS MEASUREMENTS AND CONTROL INTEGRATION

Richard Watkins, Marialena Nikolopoulou, Giridharan Renganathan, Alkis Kotopouleas

University of Kent

The Jarman Building, School of Arts, University of Kent, UK

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The naturally ventilated, three storey School of Arts Jarman Building provides two dance studios, an exhibition gallery, teaching rooms, video editing suites and offices. The main dance studio is double-height, has underfloor heating and accommodates sixty people. Fresh air enters from low level perimeter louvres and exits at high level through a stack that rises through the third storey to a stack terminal with motorized louvres. Tracer gas (CO2) measurements were used to measure the ventilation rate in conjunction with hot-wire anemometry in the stack tower. The results showed that when all air inlet and exit louvres were set to closed, the residual air flow up the stack was 0.33m3/s representing a potential heat loss of 9kW in winter at 0°C outside. When the louvres were all open, the air flow increased to between 0.49 and 0.62m3/s, a level consistent with the studio's design occupancy. It was found that the studio's 4m high perimeter curtains represent a barrier to fresh air entering the main room space and cause the incoming air to migrate upwards towards the stack exit and effectively bypass the central part of the studio. Tracer gas decay rates showed that the main space experienced an air exchange rate 50% less than that for the overall studio. An investigation of the controls also revealed that the underfloor heating system operated independently of the control of the stack ventilation system, leading to simultaneous heating and venting. The research shows the vital importance of prescribing contractually that key controls are integrated, that fresh air dampers are well-sealed when closed, and the importance of designing a fresh air supply that matches the way a space is used.

KEYWORDS: *NATURAL VENTILATION, STACK VENTILATION, UNDERFLOOR HEATING, CONTROLS, INTEGRATION, TRACER GAS*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Improving perFORMance

3rd Parallel Session

DAY 2

14:00 – 16:00

CHAIRMEN

Alberto Bruno ..... Table 7
Giulia Pentella ..... Table 8

APPLICABILITY OF TRADITIONAL TRANSITIONAL SPACES IN MODERN RESIDENCES

Rashmei Sangtani Choudhary

AA SED Sustainable Environmental Design,
Architectural Association School of Architecture, London, UK

Courtyard in a wada

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

With architecture taking on a more global language, it has become very easy to develop interesting contemporary designs anywhere in the world. Different architectural designs and standards of living are easily accessible to people which blur the lines between geographical context and traditional lifestyles. This has led to a disconnection between the contemporary and the local architecture of a place. What was it about our traditional houses that made them more robust and comfortable in a time where there was no additional help of mechanical ventilation and artificial lighting? What can we learn from our past, and how can we make it a sustainable solution in the present. This paper examines the transitional spaces in the vernacular architecture of Central India, and incorporates them in a contemporary house to help in providing comfort to the main structure and reducing its cooling loads. It also looks at designing a different spatial quality so these become interesting semi-outdoor breakout spaces in an otherwise introverted housing typology.

KEYWORDS: *Transitional Spaces, Modernizing vernacular architecture*

TOWARDS INTEGRATED DESIGN STRATEGIES FOR IMPLEMENTING BIPV SYSTEMS INTO URBAN RENEWAL PROCESSES: PRELIMINARY CASE STUDY IN NEUCHÂTEL (SWITZERLAND)

Sergi Aguacil - Laboratory of Architecture and Sustainable Technologies (LAST)
École polytechnique fédérale de Lausanne (EPFL)
Sophie Lufkin, Emmanuel Rey - LAST-EPFL

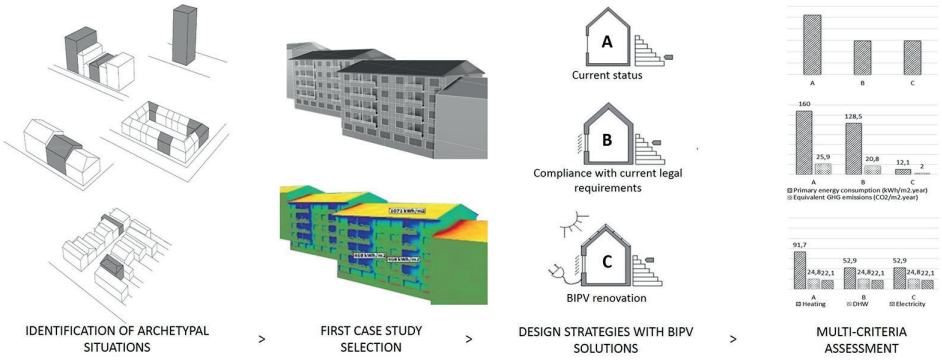


Diagram of the proposed research methodology

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

European energy directives define highly-demanding performance standards, from zero-energy buildings to positive-energy buildings. In Switzerland, one of the specific objectives of the new "Energy strategy 2050" is to install PV systems on existing building surfaces in order to cover 1/3 of the annual Swiss demand for electricity. In view of the considerable importance of urban renewal processes, building-integrated photovoltaic (BIPV) systems therefore provide a crucial response to the challenges of the energy turnaround. However, in spite of technologic progress and economic evolution, diverse types of obstacles limit a large-scale advanced PV integration into urban renewal processes.

In this context, urban and architectural design towards increased integration – and therefore increased acceptance – provides an essential solution to overcome these barriers. It represents a key element towards establishing a systematic link between BIPV and the necessary renewal of the considerable existing building stock. Towards this aim, the present paper proposes a first approach to define a holistic multi-criteria assessment methodology for BIPV-adapted solutions in urban renewal design processes in the Swiss context. This document presents the first steps towards the validation of the proposed methodology through a preliminary case study in Neuchâtel (Switzerland).

KEYWORDS: *BUILDING-INTEGRATED PHOTOVOLTAICS, ENERGY EFFICIENCY, RENEWABLE ENERGY, SUSTAINABLE ARCHITECTURAL DESIGN, URBAN RENEWAL*

SOLAR ATTICS FOR HOMES IN SOUTHERN CHILE

Lorena Troncoso, Rodrigo García Alvarado,
Paulina Wegertseder
Universidad del Bío-Bío

Pekka Heikkinen
Aalto University

conceptual image of solar attics proposed

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

It proposes a timber roofing system to build attic extensions with hybrid solar panels for existing housing in the south of Chile, in order to provide new living spaces and self-generation of energy. Most people in the zone live in detached houses that have high consumption of energy, but also extensive upper surface. The hybrid panels combine thermal and photovoltaic collectors to provide energy for electricity, hot water and space heating, but require suitably orientated roof surfaces and a high initial investment. Thus, parametric design is used to define an optimal roof extension volume for each house with industrialized construction pieces and new rooms that can have mortgage financing. This development is based on a review of the energy demands and solar potential of houses in the main city in the region, also available as an online map. Further analysis of the relationship between roof conditions and hybrid equipment revealed that panels placed on a large and good oriented roof section could provide over five times the electricity demand and more than a half of the hot water and heating needs. Parametric programming with genetic algorithm was then carried out to determine, for different layouts, which shape could offer the best energy performance and spatial capacity at the lowest construction costs. A timber structure is proposed for the attic extension that can be industrialised and provides a warmer indoor. Tests are also being carried out with solar panels, scale models and a full-scale prototype with integrated equipment, to verify its implementation and functioning and to use for promotion to local companies and inhabitants.

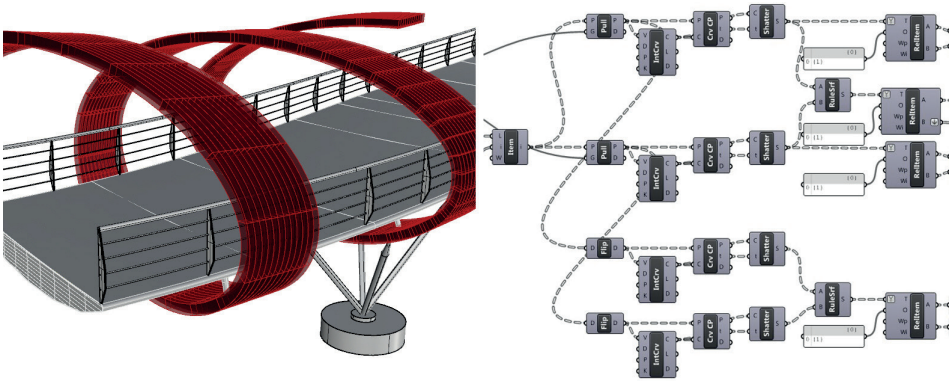
KEYWORDS: *Solar Energy, Building-integrated Photovoltaics and Thermal, Detached Housing, Chile*

PARAMETRIC AND GENERATIVE DESIGN TECHNIQUES FOR INTEGRATED DESIGN OF GLUED-LAMINATED-TIMBER ELEMENTS

Gabriele Pasetti Monizza - Free University of Bozen

Dominik Matt - Free University of Bozen / Fraunhofer Italia

Cristina Benedetti - Fraunhofer Italia



digital fabrication of glued-laminated-timber elements

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Focusing on the Italian market, according to ISTAT surveys published in 2011, building industry (BI) is one of the less efficient industries and the productivity gap with other industries is growing faster. This gap is due to two main reasons. Firstly, BI can be defined as an engineer-to-order (ETO) industry according to Wortmann classification. ETO means that the final product (building) needs to be designed and to be engineered when customers deliver their order, and it implies that every final product is almost unique. Secondly, despite supply-chain system is similar to other ETO industries, BI identifies different responsible figures for each process usually structured in a serial workflow. Serial workflow reduces the efficiency of information management by enhancing the propagation of errors.

Today, the challenge for BI is to reduce the productivity gap with other industries by reducing the wastes of resources and improving the overall efficiency of the supply-chain system. Improving the overall efficiency in BI may generate huge benefits: reduce social and economic costs, reduce the environmental footprint and enhance the quality of the final products (buildings).

This paper will discuss the early first steps of a research activity that aim at testing whether parametric and generative design techniques may offer a solution for improving design and engineering process towards a more efficient manufacturing process. Focusing on the case study of the glued-laminated-timber industry, the main goal of the research is to highlight benefits and criticisms on the overall supply-chain system in the BI and to identify possible strategies in order to introduce these techniques in the ordinary supply-chain system.

KEYWORDS: *Building engineering, timber engineering, design methods, parametric design tools, process management*

SOLAR ACCESS DESIGN IN THE TROPICS: THE THERMAL STRATEGY OF TOMAS SANABRIA

Cristina Montoya Castillo, Lucelia Taranto Rodrigues

University of Nottingham

Central Bank of Venezuela (CBV) and its thermal strategy

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In this work, the authors investigated solar access and thermal performance for a typical floor of the Central Bank of Venezuela, designed by Tomas Sanabria and completed in 1971, a modernist building located in Caracas, Venezuela where the climate is hot and humid. The building is of interest because it uses external solar shading devices on windows and walls to control the internal temperature. On the north and south façades a triple concrete skin was used, whereas on the east and west façades external concrete fins were used to provide shading to the wall. The architect was particularly interested in the use of fins on the east and west facades, which in the tropics receive the highest levels of solar radiation. To justify the cost of using concrete fins over the whole building, he recorded temperatures on two different floors during construction and related the use of the fins to lower internal temperatures due to their shading effect and the principle of thermal inertia. The focus of the study was to investigate the impact of the external facade elements on the internal temperature, explored through the use of dynamic simulation for thermal and daylighting performance analysis. Four cases were modelled: the building form without solar shading, with solar shading to the north and south façade, solar shading to the east and west façade and solar shading to all façades as was built. Each case was then assessed against four ventilation conditions. The results showed that there was a significant performance difference between the cases with and without solar protection on its four façades. The presence of fins on the east and west façades reduced temperatures by between 5-10%. This could be partially attributed to the shading provided, and to the higher thermal mass from the extra concrete.

KEYWORDS: *Thermal inertia, Thermal comfort, Tropical architecture, Shading device design, Tomas Sanabria*

LEARNING FROM THE TRADITIONAL JAALI OF INDIA

Pavitra Sanath Kumar, Simos Yannas

AA School of Architecture London

Jaali in Diwan i Kas, New Delhi

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In vernacular architecture the Jaali is a perforated building element that is used in the place of a wall or window. There are various types of Jaali, depending on materiality, geometry of their openings and/or the size. Environmental attributes of a Jaali are provision of air flow through its openings thus enabling air exchange rate of the spaces it serves, to regulate the admission of direct solar radiation and day light diffusion.

From the vernacular architecture of different regions within India we find several distinct types of Jaali. A recent project studied the Jaali in three different regions respectively hot semi-arid, humid sub-tropical and tropical monsoon climates. The fieldwork was followed by physical modeling to test new patterns and geometries of perforation. The research has resulted in design guidelines based on climate and indoor comfort requirements.

KEYWORDS: *Vernacular architecture, Jaali, Air-exchange, Solar Radiation, Day-lighting, Hot Semi Arid, Humid Subtropical*

THE KERKENES ECO-CENTER: A SHOW-CASE FOR APPROPRIATE HOUSING AND SUSTAINABLE DEVELOPMENT IN RURAL TURKEY

Françoise Summers - Kerkenes Eco-Center Project

Prof. Soofia Elias-Ozkan, Matthieu Pedergnana
Middle East Technical University

Construction of the straw-bale house at the Kerkenes Eco-center

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A fast developing country, Turkey faces many challenges including an urgent need for sustainable economic development in rural and remote areas. Villagers in Central Anatolia, where climatic conditions are typified by very cold winters and hot, sunny and dry summers, are migrating to cities where they seek a more comfortable life style. Thus village economies have worsened and buildings have been abandoned. The Kerkenes Eco-Center, located on the edge of Şahmuratlõ Village in central Anatolia, was founded in 2002 as a response to this situation. By bringing together village residents, local and state officials, NGOs, students and academics, the Eco-Center strives to advocate sustainable rural development and to act as a dynamic experimental base where buildings of traditional and alternative designs can be constructed and monitored. As a response to villagers' needs for comfort, low-cost construction, and low-maintenance buildings "new" designs and techniques, such as straw-bale walls, have been introduced while traditional practices such as flat roofs and sun-drying techniques have been improved.
This paper presents the results of research and hands-on activities which go a long way towards demonstrating the viability of alternative building techniques. Not only is the efficiency of the proposed solutions evaluated, but also the social impact and advantages brought to the village are examined. Buildings within the Kerkenes Eco-Center are continuously monitored and results analyzed while simulations are used to generate the optimum models for energy efficient designs. New buildings and solutions are implemented according to the results obtained. Hence on-going studies, including straw-bale construction, passive solar heating and integrated rocket stoves, make it possible to propose solutions for a sustainable rural life and viable future.

KEYWORDS: *Energy efficiency, appropriate building material, sustainable rural development.*

CASA FENIX. FROM THE SDE 2014 COMPETITION TO THE RECONSTRUCTION AFTER THE 2014 URBAN FIRE OF VALPARAÍSO, CHILE

Nina Hormazábal, Pablo Sills, Andrea Pino, Miguel Ángel Gálvez, Sebastián Rojas, Alejandra Carrasco, Carolina Sepúlveda

Univ. Técnica Federico Santa María

Las Cañas Hill reconstruction area after April 12th, 2014 Valparaíso Fire. Center: Casa FENIX HC

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

One aspect that unfortunately characterizes Chile because of its varied geography is the relatively constant threat of natural and provoked disasters, such as earthquakes, volcano eruptions and urban fires, among others. The regularity with which these events occur does not make them any less catastrophic for people. Chile has been considered a developing country for some time, but the most immediate consequence of these disasters is the sudden increase in homelessness. Many homes are lost and the people who are most affected are the most socially vulnerable population. The problem: While Chile is a political and geographical location where natural disasters are recurrent, there are no official policies which outline a quality response to such events. When disaster strikes, the problems are resolved with quick, cheap, short-term solutions, such as the 'mediagua', an emergency shack created in 1965, which end up causing more problems than they solve and lead to a great deal of waste in the long term. Objective: To create an affordable solar home that offer quick, good quality and energy efficient home for the victims of a disaster. Casa FENIX proposes to focus mainly on local cultural aspects, quality of life and social relationships, within sustainable development, where the use of sustainable energy technologies and sustainable urban planning are applicable to enhance the intuitive know-how of a particular population. This paper presents how Casa FENIX (For Emergency post-Natural Impact eXtreme) concepts of a solar emergency home that participated in the Solar Decathlon Europe 2014 competition, have evolved through participatory design involving victims of a disaster to be part of the reconstruction of their own homes. It will portray the first Casa FENIX adapated and designed for and with a family that lost their incremental self-built home where they lived for 27 years.

KEYWORDS: *SDE COMPETITION, SOCIAL SOLAR HOME, NATURAL DISASTERS*

PINES CALYX EARTH TUBE PERFORMANCE

Keith Bothwell - Kent School of Architecture, University of Kent, Canterbury, UK

Richard Watkins - Kent School of Architecture

The Pines Calyx building in its coastal setting

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

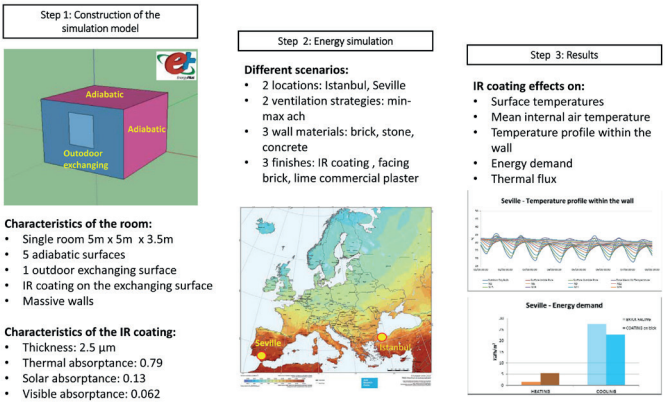
In temperate climates earth tubes achieve increased comfort in summer and the pre-heating of inlet air in winter, reducing the requirement for cooling and heating. This strategy was adopted to pre-temper air entering a small conference centre building in Kent, UK. The earth tube is about 16m long comprising a concrete pipe with an internal diameter of 0.6m. The pipe is located approximately 1.5m below ground level. A very low energy fan at the outlet end draws air through the tube and pushes it through a heat exchanger before it is distributed via ducts in the building. This paper reports on the results of monitoring the earth tube temperatures and air velocities under different weather conditions. Temperature sensors were positioned externally and at both ends of the earth tube. An anemometer was fixed in place 4m from the inlet end. This 'fixed' anemometer in the earth tube was calibrated and the velocity profile of the air flow in the tube was established. The air in the tube was found to have an almost uniform velocity profile, which is likely to be caused by the considerable turbulence created by changes in the direction of the tube, and the dimensions of the pipe relative to the flow rate. This indicates that the system was well-designed to maximise the heat exchange potential of the duct. The energy contribution of the earth in pre-heating and pre-cooling the air has been calculated at approximately 500W for each degree Kelvin raised or lowered, compared to only 18W power consumed by the fans. This demonstrates that earth tubes can make a very significant contribution to providing heating and cooling, with very low carbon emissions. Earth tubes are a durable and low-cost method of providing resilience in the face of climate change.

KEYWORDS: *EARTH TUBES, EARTH COOLING, PASSIVE DESIGN, LOW ENERGY DESIGN, NATURAL VENTILATION, PASSIVHAUS PRINCIPLES, HYBRID SYSTEMS, MIXED-MODE SYSTEMS*

EFFECTS OF RADIATION REFLECTIVE COATINGS APPLIED TO MASSIVE WALLS

Francesca Roberti, Elena Lucchi, Alexandra Troi

EURAC



Steps of the infrared reflective coating analysis

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Reflective coatings reflect the infrared incident radiation on a surface, reduce the radiation absorbed by the building surfaces and therefore decrease the cooling energy consumptions during summer. They are used mainly on the horizontal surfaces of light construction buildings to create cool roofs. Today they are also applied on the outside vertical surfaces to prevent overheating during summer. Reflective coatings change the reflective properties of the surfaces, modifying the thermal performance of the whole building envelope. It is therefore important to analyse them integrated in buildings with different users´ behaviours and construction technologies. In particular, this paper focuses on their application on existing buildings with massive walls (stone and brick masonries). We performed thermal simulations with the software EnergyPlus on a reference room located in two climates with different solar radiation values: Istanbul (TUR) and Seville (ESP). To have many scenarios, we change step by step the following parameters: (i) surface orientation; (ii) internal natural summer ventilation; (iii) internal conditions, (iv) stratigraphy and (v) materials of the exterior walls. We analyse the temperature inside the walls, the temperature of the outside and inside surface, the heat flux entering and leaving the treated surface. We calculate the energy consumptions during the whole year evaluating the coating effects on walls made by stone, brick and concrete.

KEYWORDS: *REFLECTIVE COATING, INSIDE WALL TEMPERATURE, SURFACE TEMPERATURE, ENERGY CONSUMPTIONS*

DURABILITY, USE AND RE-USE OF BUILDING STOCK

Riccardo Pollo, Andrea Levra Levron

Politecnico di Torino

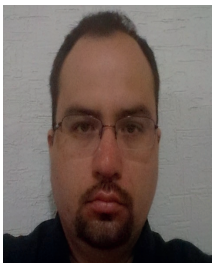
Social housing in the Turin area managed by Territorial Agency for the House (ATC Torino)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A substantial share of the building stock in Europe is older than 50 years. Many buildings in use today are hundreds of years old. More than 40% of our residential buildings have been built before the 1960s, when energy building regulations were very limited. The energy consumption and emissions are actually very significant. The refurbishment and renovation of the building stock is the main issue in the government agenda. Furthermore the maintenance and refurbishment is the most important activity of the European construction sector. Nevertheless the regeneration of housing estates of our suburbs is a complex topic common to major European cities. The decision to refurbish or demolish and rebuild the large building stock built during the sixties and seventies of the last century requires a deep evaluation of social, economic and technological issues. The buildings, in particular the public and social housing, are mostly obsolete in terms of layout, energy performances and durability. The topic of refurbishment of public housing is very complex and also the technological aspects are becoming more significant facing the challenge of energy consumption and emission reduction and accomplishing sustainability. One of the most important issues to allow the responsible use of natural as well as financial resources is the feedback from building use and operation to the design. The lack of information about the service life of buildings can be overcome by design tools and procedures to evaluate durability and performances of the building and components over their life time. The research suggests the use of methods of analysis of Failure Modes and Effects Analysis (FMEA) to develop a procedure for the service life prediction and prevention of defects. Through the model the reliability of such data is properly managed by a probabilistic approach and the probability of failure related to environmental agents, users, quality of materials and components, design options and workmanship skills is estimated.

KEYWORDS: *building refurbishment, building envelope, FMEA (Failure Mode and Effect Analysis), Durability, Service Life Planning, defect*



FUNNELLING WINDOW: EXPERIMENTAL STUDY OF VENTILATION PERFORMANCE

Adolfo Gomez-Amador - Universidad de Colima
Marcos Gonzalez-Trevizo - Universidad Michoacana de San Nicolas de Hidalgo
Gonzalo Bojorquez-Morales - Universidad Autonoma de Baja California
Jesus Komaba Quezada - Instituto Tecnologico de Chihuahua II
José Francisco Armendariz Lopez

Funnelling windows at the experimental setup.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In order to improve the conditions of habitability in architectural spaces, especially in state-subsidized housing, devices with a low economic cost and low power consumption are recently studied. Under conditions of sub-humid warm climate; as the existing ones in Colima city (19°15'N; 103°44'W and 450m a.s.l.), the best passive design strategy to avoid electrical air conditioning is the natural ventilation. Due to this, there are some expectations to improve thermal comfort conditions in inhabited spaces through the use of design patterns in facade window that increases wind speed based on Venturi effect. This research reports on the operation of three devices with different design configurations to increase the wind speed, based on different inlet-outlet size ratio in the window. The cooling effect of the natural ventilation was estimated with the Szokolay´s model dT=6VxV2.
The study period was carried out from February to March, since this is the season when prevailing wind direction remains perpendicular to test modules where devices were installed. When air inlet reduction were 25%, 50% and 75% regarding the outlet size, the wind speed increases from 1.06 m/s to 1.33 m/s (25%), from 0.94 m/s to 1.28 m/s (37%) and from 0.90 m/s to 1.40 m/s (56%). This represents a potential decrease in temperature of about 0.28°C, 1.29°C y 1.86°C respectively, in compliance with Szokolay and mean speed values recorded in the inlet side of the window.

KEYWORDS: *Natural Ventilation, Venturi effect, Window, Passive design.*

LESSONS FROM A BEDOUIN: DESERT ADAPTIVE ARCHITECTURE

Rawan Suheil Qobrosi, Paula Cadima

Architectural Association School of Architecture

The Bedu of Wadi Rum, a culture on the brink of extinction

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This research paper examines and highlights the unique characteristics of the Bedouin tent used to withstand the harsh climate of the Wadi Rum desert. It compares the environmental performance of an original Bedouin tent with a contemporary urban tent found today within the boundaries of Wadi Rum village. The findings helped identify the nomadic qualities and strategies that can always be implemented as new environmental architectural features to improve current modern homes and most importantly preserve a rich dying culture.

KEYWORDS: *Bedouin, black tent, Wadi Rum, desert, Jordan.*

REDUCING ENVIRONMENTAL IMPACTS OF BUILDING STRUCTURES THROUGH LOCAL MATERIAL SOURCING & PROCESSING

Michael Utzinger, Layla Qarout

University of Wisconsin-Milwaukee

Aldo Leopold Legacy Center – Structural Materials: Stone, Wood, Steel, and Concrete

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Building structures and foundations typically comprise the largest fraction of the total building mass. Choosing locally sourced and processed structural materials offers the design team the opportunity to substantially reduce embodied energy and carbon dioxide emissions. Additionally, local sourcing and material processing keeps a larger percentage of construction costs in the local economy. This paper quantifies the reduction of embodied energy and carbon dioxide emissions of the structural system of the Aldo Leopold Legacy Centre due to local sourcing and processing of materials. The environmental costs of the structural system are compared with the environmental costs of the building's photovoltaic system and with the operational energy consumption and carbon emissions. Local material sourcing and processing reduced the total structure embodied energy by 685 MJ/m2 (34.5%) and CO2 emissions by 83.1 kg CO2/m2 (37.1%). The photovoltaic system embodied energy (extraction, manufacturing, transportation and construction) is 71.8% of the structure system embodied energy and 101.6% of the structure system CO2 emissions.

KEYWORDS: *EMBODIED ENERGY; CARBON EMISSIONS; HIGH-PERFORMANCE BUILDING; LOCAL MATERIALS; STRUCTURE*

DAYLIGHT AND THERMAL ASSESSMENT IN THE ADAPTATION OF INDIES ARCHITECTURE FROM TRADITIONAL ARCHITECTURE IN INDONESIA. CASE STUDY: KUDUS HOUSE, TOKO MERAH AND GEDUNG JOEANG

Nadia Lasrindy, Brian Ford, Benson Lau

University of Nottingham

Kudus House (Oetama, 2013) (Left), Toko Merah (Indonesia Travel, 2014) (Middle), Gedung Joeang (Rekomendasi Wisata, 2014) (Right)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The role of Indies architecture is important to the development of modern architecture in Indonesia. In contrast with the early colonial architecture that directly incorporates modern European architecture to Indonesia, it utilizes traditional architecture to adapt with local climate. The study aims to investigate strategies of Indies architecture to face the climate with its design feature, focusing in the daylight and thermal assessment. Three case studies were chosen to represent each architectural style. Traditional architecture was represented by Kudus House, early colonial building was represented by Toko Merah and Indies architecture was represented by Gedung Joeang. Each case study has been analyzed through each design feature and the habit of the occupants as an approach of selective design means. The assessment in quantitative study has been conducted using thermal and day lighting software assessment. Thermal assessment has reviewed the percentage of thermal comfort achieved in each building through the presence of ventilation, while daylight has analyzed each sensitive design strategy to provide an adequate room ambiance, yet can prevent the glare. In thermal assessment, traditional architecture performs well during night time, while early colonial building in day time. Indies architecture was creatively combined the both workable strategy from traditional and early colonial and provided comfortable condition throughout the day. In the daylight assessment, early colonial building was poorly performed, while traditional architecture has better daylight transition, therefore, Indies architecture improved the traditional strategy by providing occupant control to adjust daylight by the use of krepyak / louver windows.

The outcome of this study has exhibited that design features and strategies of Indies architecture, not merely worked as an attractive architecture style but also as a solution for architecture to improve the occupant's quality of living.

KEYWORDS: *Adaptation, Indies Architecture, Tropical Climate, Daylight, Thermal*

THE IMPACT OF HOUSING POLICY AND BUILDING REGULATION ON HOUSE PATTERNS AND URBAN DESIGN

Feryal F.-Al-Kurdi *University of Dammam*

Traditional and Contemporary urban design of Dammam Metropolitan Area

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The study plays a significant role in describing and understanding the development of the house form and urban design. The research studies the house form from the onset residential settlements (traditional) of the triplet cities of Dammam, Dhahran and Al-Khobar in the Eastern Province of Saudi Arabia until the contemporary era. In addition, the research determines the main factors behind the changes within each period. The analysis of changes and their associated factors gave a framework of how to design the building regulation and housing policy to match the inhabitants' needs, for the sake of appropriate dwellings and planned residential neighbourhoods that meet the needs of the population. It is important to provide the designers and urban planners with the ability to understand the urban design with its continued socio-cultural values in order to respect them and create a high-quality sustainable environment in their future design. In Summary, research findings reveals that the housing policy and building codes have a great impact on urban design, where the divisions of lands, the street layout by hierarchy and the even public utilities determining the house form and layout, in terms of overall space organization, types of rooms, utilization and house facades.

KEYWORDS: *Home Environment, Housing Policy, Building Regulations, Urban Design, Residential Neighbourhoods, Social and Environmental Challenges.*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Knowledge Transfer

1st Parallel Session

DAY 1

14:00 – 16:00

CHAIRMEN

Alberto Bruno ..... Table 9
Maureen Trebilcock ..... Table 10

ENERGIE+: AN ONLINE DECISION-MAKING GUIDE TO SUPPORT ENERGY EFFICIENCY IN TERTIARY SECTOR BUILDINGS

Cuvellier Simon, Dartevelle Olivier

Université catholique de Louvain

ENERGIE+ web guide (www.energieplus-lesite.be)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

ENERGIE+ is a free decision-making guide available online and helping to check and to act on the energy consumptions and costs of building(s) in tertiary sector. It is mainly intended for the Energy Managers but also for architects, designers, installers or anyone in charge of energy in non-residential buildings, with a focus on renovation, construction, managing and raising awareness in projects aiming at energy efficiency. The structure of the information about energy, comfort, building and HVAC techniques and components is split into two parts. The first part, called The Decision-Making, is more practical and gives critical analyses and advices according to the project's phase: Manage, Evaluate, Improve and Design. The second part is more theoretical and is called The Resources. It describes the systems and the components of a building, presents physical building theories, provides calculation tools, explains the different European and Belgian regulations, shows the measurement techniques and develops some case studies and relevant technical and physical values.

This paper presents the purposes, the structure and the impact of the almost 800 times daily-visited online free ENERGIE+ guide which is a project of energy efficiency promotion and aims at the transfer of a large range of scientific and technical knowledge directly to the person in charge of the energy management in a public or private institution.

KEYWORDS: *ENERGY PERFORMANCE, GUIDE TOOL, TERTIARY SECTOR, RETROFITTING, ENERGY EFFICIENCY DESIGN*

RETHINKING SOCIAL HOUSING THROUGH POST-OCCUPANCY INVESTIGATIONS PART 1, PROJECT CASE IN JAPAN AND RESULTS

Genku Kayo
Aalto University

Nobue Suzuki
Freelance

Eleven houses with three different designs open to a common garden

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

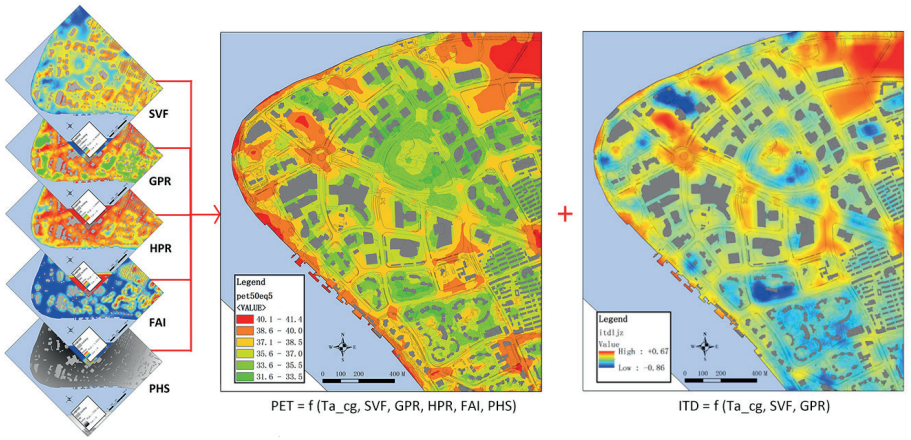
The Japanese government implemented a revised national energy-efficiency standard in 2013 in order to further reduce energy use in the housing sector, and local municipalities implemented various actions to meet the government's objectives. One action is addressed towards social housing projects, in order to provide energy-efficient houses for low- and middle-income citizens. This action includes encouraging local architects and construction companies to develop their competences for building energy-efficient houses. This article describes a social housing project in Yokohama city municipality. The project included implementation of post-occupancy investigations between July 2012 and March 2014. All of houses satisfied the criteria required by the city. Seasonal investigations clarified that the natural ventilation strategy effectively controlled indoor climate in the summer. However, it also clarified that cold interior conditions occurred in the winter. An analysis of Home Energy Management System data shows that energy use for space heating in winter occupied a large percentage of the total. The post-occupancy investigations have provided a large amount of useful experience and have substantially increased our understanding of the challenges involved in realising a passive design that can function optimally over the entire year.

KEYWORDS: *Social housing project, community, thermal environment, energy performance*

DEVELOPING A THERMAL ATLAS METHOD FOR CLIMATE-RESPONSIVE URBAN DESIGN BASED ON EMPIRICAL MODELING AND SPATIAL ANALYSIS

Feng Yang
Department of Architecture, Tongji University

Liang Chen
East China Normal University



Summer daytime thermal atlas of Shanghai Lujiazui CBD (index: PET, ITD)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper aims at developing a thermal atlas method, that can be used as a decision-supportive tool at the urban district scale, to evaluate the thermal environment and identify optimization potentials, in order to alleviating urban heat island effect and outdoor thermal discomfort. The method can be an interesting alternative to the prevailing CFD-based tools, which are unfamiliar and not user-friendly to architects and urban designers. Shanghai Lujiazui Central Business District (CBD) is chosen as a case study and test bed for the method. Based on previous work and a systematic review on the state-of-the-art in urban climatology, we first choose key morphological variables from six categories, i.e. urban form, density, land use, greenery, ventilation potential, and proximity to heat sink. We then compute and map these variables using urban morphometric and geographical information system (GIS) based spatial analyst tools. Micrometeorological measurement was carried out on peak summer days. Intra-urban temperature differentials and thermal comfort indices are correlated with the morphological variables in order to build regression models. The variable layers are then overlaid based on coefficients (weights) determined by the empirical models, to generate the thermal atlas. The method can rapidly calculate and visualize thermal variations caused by urban design variations, thus can be a useful tool for architects and urban designers, in climate-responsive urban design.

KEYWORDS: *URBAN CLIMATOLOGY, MICROCLIMATE, URBAN DESIGN, URBAN MORPHOMETRY, THERMAL COMFORT*

DESIGN FOR BEHAVIOURAL CHANGE: THE LOG CABIN PROJECT AT OTATARA

Mazin Bahho
Eastern Institute of Technology/VUW

Brenda Vale, Taciano Milfont
Victoria University of Wellington

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Although architects and designers have been practically involved in influencing people's behaviour through the planning and design of human environments, behaviour intervention studies are not yet common within design research (Lockton et al., 2013, p. 432), being more established in social and environmental psychology and allied fields. Additionally, having a demonstration sustainable building is a recommended instrument to bring about change in community choices, behaviour, and construction practices (IEA SCH Task 40, 2012). Given this, the Log Cabin Project at Otatara, Hawke's Bay, New Zealand, is an opportunity to bring these two approaches together.

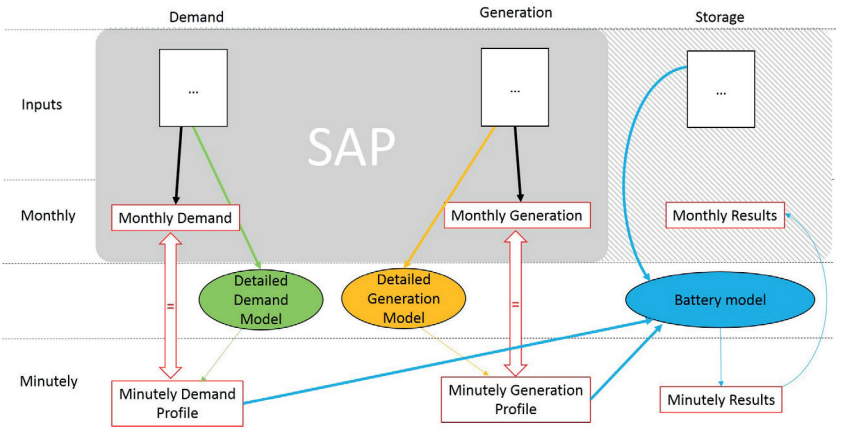
This research is about refitting an existing building to be a facility for exhibiting sustainable building practices for the community. It is also an experiment with which to examine the potential for influencing pro-environmental behaviour in those associated with the project at the different stages of the building process, including an investigation of the values they hold. This paper, which is part of ongoing doctoral research, describes the development of a method for this investigation to understand and analyze why certain people became engaged in the project and their attitudes towards behaving sustainably. Interviews with the first group, the student designers, highlighted the importance they give to living sustainably and valuing ecological and organic living practices, whereas interviews with the second group, the project sponsors, stressed the importance of a balance between sustainable solutions and affordability, and emphasized the significance of giving the public tangible solutions for sustainability.

KEYWORDS: *BEHAVIOUR FOR SUSTAINABILITY, VALUES, DEMONSTRATION PROJECT*

REPRESENTING DYNAMIC STORAGE IN A NATIONAL CALCULATION METHOD

Heledd Iorwerth, Simon Lannon

WSA, Cardiff University



Overview of Method

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

With the growth of domestic renewable energy generation, the suitability of and need for increased self-consumption becomes more apparent. Mechanisms for self-consumption are progressively being developed within the EU. This could reduce the stress on power supply systems by reducing the amplitude of potentially large energy fluctuations. In addition, the future decrease in feed-in tariffs is likely to increase the economic viability of such methods. The potential take up of such methods will require National Calculation Methods to be capable of evaluating their impact on individual dwellings' consumption.

The objective of this research is to develop a method of representing dynamic processes such as techniques of increasing self-consumption in steady state National Calculation Methods. In this paper, a method of feeding data into and out of a steady state model to simple external models with shorter time steps is explored. As a preliminary trial, the detailed modelling of PVs and battery storage is considered and a method developed for evaluating its impact within the UK's National Calculation Method for dwellings – the Standard Assessment Procedure. It was demonstrated that with slight changes to the current Standard Assessment Procedure methodology, results of detailed simulations of dynamic processes could be incorporated in future versions. It is hoped that the example of a detailed external PV and battery storage calculation presented in this paper provides a possible approach to achieving the likely future requirement: for National Calculation Methods to be capable of evaluating the impact of self-consumption techniques on dwelling's energy performance.

KEYWORDS: *Storage, National Calculation Method, Energy Demand, Energy Generation, Simulation, Model, Standard Assessment Procedure*

THE EFFECT OF REAL-TIME CONTEXT-AWARE FEEDBACK ON THERMAL COMFORT AND HEATING ENERGY USE: A CASE STUDY

Marika Vellei, Sukumar Natarajan, Ben Biri, Ian Walker, Julian Padget

University of Bath

Outline of the feedback smartphone application

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

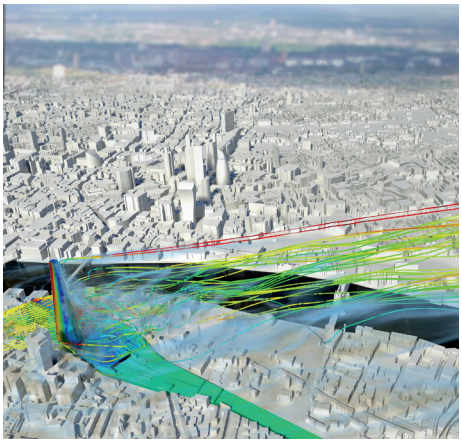
Variable occupant behavior is now being recognized as a significant factor in determining overall building energy use. Therefore, prompting correct energy behaviors represents a social, environmental and economic challenge of today. Real-time feedback can constitute a solution to this challenge. However, there is still a lack of knowledge and empirical proof to support their implementation. This paper investigates the effect of real-time context-aware feedback on occupants' adaptive behavior, perceived environmental control and thermal comfort. We report results from a six-week winter field study, with in-depth monitoring using environmental, CO2 and motion sensors in 15 student rooms at a UK university. Subjective data were concurrently collected through questionnaires (thermal sensations, clothing levels and adaptive responses). In the last three weeks of the experiment, students were provided with real-time feedback through a dedicated smartphone application. From a preliminary analysis of the results it emerged that a decrease of radiator and room temperatures were achievable without affecting the comfort of occupants. Students felt having a greater control over their thermal environment and, consequently, this greater control was able to mitigate their thermal expectations and offset discomforts due to the lower temperatures. This study supports the idea that saving energy does not always mean sacrificing occupants' environmental satisfaction.

KEYWORDS: *Real-time feedback, Thermal comfort, Adaptive behaviour, Heating energy consumption*

URBAN WIND MICROCLIMATE: A NEW METHOD TO CORRELATE WIND SPEEDS WITH PEDESTRIAN COMFORT CRITERIA

Camilo Diaz, Amedeo Scofone

WSP UK



Wind streamlines showing trajectory and speed using CFD modelling

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper presents an approach to correlating wind conditions calculated by wind modelling with wind environment criteria in urban areas. One of the key challenges faced by designers, planners and developers today is the provision of high quality open spaces within the urban context. In the UK, as planning authorities increase their requirement that all new public open spaces meet the highest comfort and safety standards for pedestrians, and that the quality of the existing public realm must be preserved, it is an increasing challenge for designers to demonstrate adherence to good practice design. Assessing a development's impact on the local microclimate is a key part of the planning process for major development projects. In particular the evaluation of wind effects is an area of growing interest in the planning and design of new developments, especially where large buildings are involved. Wind tunnel measurements and Computational Fluid Dynamics (CFD) have been used extensively to quantify wind speeds in urban environments. Examples of the application of CFD codes for Computational Wind Engineering (CWE) have been researched and reported (Palmer G. Vazquez B, et al. 2003). There are several methods and criteria developed to assess the effect of wind on pedestrian comfort and safety and comparisons between these have been investigated (Janssen W., Blocken B, van Hooff T, 2012). In the UK, most wind comfort assessments are based on the Lawson criteria (T.V. Lawson 2001). These are preferred because they have been calibrated by BRE and others, against wind conditions around real developments (Blackmore, 2011). The method described in this paper uses wind speed data generated through CFD modelling for a particular site and establishes a statistical correlation with long term wind data records for comparison against the Lawson criteria. [...]

KEYWORDS: *Computational Fluid Dynamics, Urban Wind, Urban Microclimate, Pedestrian Comfort and Safety, Lawson Criteria,*

AULA AMBIENTAL: A METHODOLOGY FOR DELIVERING (AND PROMOTING) COMFORTABLE AND RESILIENT SCHOOL BUILDINGS

Maureen Trebilcock, Jaime Soto, Rodrigo Figueroa, Beatriz Piderit

Universidad del Bío-Bío

School building in Iquique, in the north of Chile

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

School buildings around the globe represent a building typology that is usually completely passive, as many times they have neither a heating nor a cooling system. However, indoor environmental quality in school classrooms is not always acceptable; many students are required to spend long hours in an environment that may be too cold or too hot, have poor indoor air quality or be too noisy for them to be able to perform adequately. This paper presents the results of an on-going research project focused on school buildings in Chile, which aims to develop a methodology for delivering and promoting comfortable and resilient schools. Based on fieldwork in schools throughout the country, the methodology was oriented toward determining comfort temperatures that are suitable for school children in totally or partly free running buildings. These proved to be considerably lower than current standards due mainly to the resiliency of the children who are accustomed to very low or very high indoor temperatures in their classrooms. In addition, the methodology included the development of a tool to visualize the results of thermal simulations in passive buildings when the output is indoor temperature instead of energy demand. With this tool, designers can easily visualize if they are meeting desired thermal comfort standards, helping to promote comfortable passive school buildings that would be resilient to climate change challenges, as well as to the challenges imposed by fuel poverty. The third component of the methodology consists of a method for calculating productivity in school buildings in relation to environmental comfort, which aims to establish the benefits of improving the quality of the building in terms of the health and wellbeing of students, instead of reducing operational energy costs.

KEYWORDS: *THERMAL COMFORT, SCHOOL BUILDINGS, RESILIENCE, CHILDREN*

TE-ENERGY FOR SYNERGY: A PRACTICAL TOOL FOR ENERGY EFFICIENCY IN THE SCHOOL DESIGN

Prof., Arch. Paola Gallo, PhD., Arch. Rosa Romano

University of Florence, Dida

The Teenegy guidelines: Cover and an example of thematic contents.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In the next years, in correspondence of the crisis of the new buildings production, there will be a renaissance of the urban and building refurbishment, in particular of the existing public domain. The construction industry, as a result of this situation, has need to find new revamp strategies to individuate new objectives and new financing and technical tools.
The Horizon 2020 EU program, with the pillar Social challenges, includes studies and research related to Energy sources, clean and efficient and Society inclusive, innovative and secure.
Therefore, it is necessary to rethink the future of construction sector and in particular the existing public assets, according to new challenges and new strategies.
The school buildings' safety and their energy requalification need to be primary goals in order to save this building sector, since they create an occasion to bring development, to contribute to urban regeneration, and to save the Italian construction industry from the present situation of emergency.
It is necessary to give an answer at this necessity, focusing on the implementation of a common method on decisional support for the Public Administrations, in order to find the basic technical indications and criteria to decrease the public investments in energy purchase improving the energy performances and the indoor comfort in the school buildings.
The challenge of this work is to demonstrate the effectiveness of instruments and financial resources in promoting technological innovation, in this specific construction industry, as a vehicle to transform obsolete schools buildings, in Nzeb, as indicated from the latest European legislation on energy performance of the buildings

KEYWORDS: *Energy Audit, Sustainable Schools, Energy Saving, Refurbishment Strategies, Management and Planning Instruments.*

URBAN MORPHOLOGY AND ENERGY PERFORMANCE IN THE 20TH CENTURY PUBLIC CITY: THE CASE OF ROME

Michele Morganti, Carlo Cecere
SOS_UrbanLab - DICEA - Sapienza, Rome

Antonio Isalgue, Helena Coch
AiEM - UPC School of Architecture, Barcelona

Aerial images for some public housing neighbourhoods in Rome (1970s-1980s).

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A vivacious discussion focusing on the 20th Century public housing neighbourhoods' urban regeneration and densification amongst academics and practitioners working in architecture and urban design is ongoing. Two main focuses of analysis have been investigated: the different transformation strategies and the relationship between urban morphology and energy performance in the existing urban fabric. At present, these focuses need to be developed into an integrated approach determining tools and design methods at urban scale. Our study presents a contribution to the energy analysis and related design tools at urban scale permitting to determine more efficient conditions for the 20th Century public housing neighbourhoods. It has been carried out within the public building stock of Rome which globally represents the 12% of the urban footprint: an ideal environment to test urban scale design methods for urban regeneration in Mediterranean climate. The relation between morphology and energy demand has been investigated taken into account different spatial density definitions as useful indicators to illustrate this kind of relation. Among these indicators, those more suitable to express reliable trends in relation to energy demand have been determined. The analyses have been conducted with Design Builder and Energy Plus simulation tool. This paper present and discuss results for three case studies. Building intensity (FSI) and coverage (GSI) show that density has relevance on energy demand for heating and cooling. Especially at islands scale, these indicators seem to be more adequate to describe this relation. The investigation on these kinds of performances achieved by density indicators help comprehend the different behaviours in each urban fabric. Methodological structure and the determined parametrical tools show themselves as knowledge base for aware design transformations of this housing building stock.

KEYWORDS: *URBAN MORPHOLOGY, SPATIAL DENSITY, URBAN ENERGY PERFORMANCE, RESIDENTIAL HEATING AND COOLING DEMAND*

IS OCCUPANT MOTIVATION THE KEY FOR ENERGY-EFFICIENT BEHAVIOUR IN HOMES?

Michal Assif, Evyatar Erell
Ben-Gurion University of the Negev

Boris Portnov
University of Haifa

typical apartment buildings in Jerusalem participating in the experiment

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The conventional energy-saving paradigm suggests that if building envelopes are constructed to a higher standard, buildings will consume less energy. Findings from an ongoing study of a sample of 120 apartments in two cities in Israel suggest that this may not be true. A comparison of the energy rating of the apartments with their actual energy use for heating and cooling showed no correlation. The effects of occupant behaviour on energy use were investigated over a period of a year, and records were made of participants' demographic characteristics, the apartment occupation patterns, ownership of home appliances and heating and cooling equipment. Monthly utility bills were obtained as a record of energy consumption. After the first year, an experiment was initiated to promote energy-saving behaviour. Apartments were divided into three groups, with different strategies to effect changes in energy consumption: a) Providing participants with comparative consumption data, relying on peer pressure and 'social competition' to provide the impetus for behaviour change, informed by generic recommendations on possible conservation measures; b) As in (a), but in addition providing detailed recommendations based on a thorough audit of the energy consumption patterns of the specific apartment owner; (c) A third group, serving as a control, received only generic pamphlets on energy conservation. The study is still in progress, but initial findings show that neither of the behaviour-changing strategies led to consistent reductions in energy use by apartment occupants relative to the control group. Motivating energy–saving behaviour remains an elusive goal that might be difficult to achieve without a substantial external shock. Alternatively, building design should be less dependent on informed occupant actions to achieve energy efficiency, with automatic controls of e.g. shading systems installed to ensure optimum performance.

KEYWORDS: *Case-control study; promoting changes in behaviour; occupant motivation*

NEW BIOCLIMATIC WEB-BASED TOOL FOR ENERGY EFFICIENCY OF RESIDENTIAL BUILDINGS IN BRAZIL

Gabriel Iwamoto, Andrea Invidiata, Alexandra A. Maciel, Roberto Lamberts

UFSC- Federal University of Santa Catarina

Photo of Internet homepage of the web-based tool

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

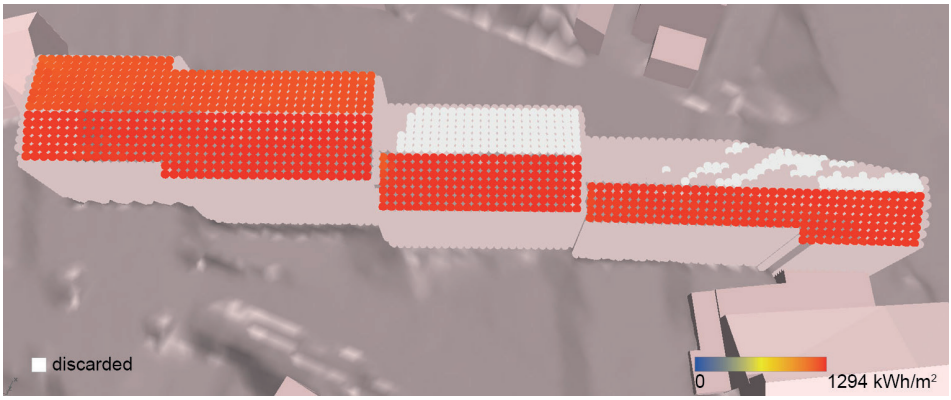
The consumption of electric energy in Brazil has grown considerably over the last twenty years. Nowadays, 48,5% of that energy is consumed by buildings; 24,2% of that in the residential sector, resulting in the highest increase of consumption per sector. The application of bioclimatic principles is one way to decrease the energy consumption of buildings. The bioclimatic design is specifically related to the understanding of local climatic features and the application of passive strategies. In the bioclimatic approach, energy saving and lower environmental impacts are consequences of the application of design solutions associated to local climatic features in order to achieve better comfort conditions. Brazil was divided in 8 climatic zones, for each one is necessary to use passive strategies to reduce energy consumption and to ensure the best thermal comfort for people. This paper presents a new bioclimatic web-based tool developed to help design residential buildings in Brazil: Projeteee. The innovation of Projeteee is the use of a adaptive thermal comfort model of the ASHRAE 55 which chooses the exact bioclimatic strategy in the different Brazilian cities. The software allows the identification of three best passive strategies and their different form of application, helping designers to improve the energy efficiency and thermal comfort of residential buildings.

KEYWORDS: *ENERGY EFFICIENCY; THERMAL COMFORT; CLIMATE ANALYSIS; BIOCLIMATIC TOOL; RESIDENTIAL BUILDING.*

SAMPLING OF BUILDING SURFACES TOWARDS AN EARLY ASSESSMENT OF BIPV POTENTIAL IN URBAN CONTEXTS

Giuseppe Peronato - Ecole polytechnique fédérale de Lausanne EPFL LIPID

Emmanuel Rey, Marilyne Andersen
EPFL LIPID



BIPV-suitable surfaces as defined by the proposed algorithm (conservative approach, threshold = 975 kWh/m2)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Although the integration of PV systems in the building envelope (BIPV) is an important factor for the acceptability of such installations, current urban-scale solar potential metrics only partially consider this aspect. As part of the definition of BIPV-suitable surfaces, we argue that a geometric-regularity criterion can help predict the possible disposition of solar panels already in the early assessment of BIPV potential in urban contexts.

To address this need, we developed an algorithm for the geometric sampling of the parts of the building envelope achieving a minimum irradiation threshold, with the aim of defining uniformly-covered active solar surfaces. The proposed methodology is implemented in a flexible parametric design platform and tested in a case study in Neuchâtel (Switzerland). We show that integrating geometric regularity in the assessment of BIPV potential can have a significant influence in the calculation of the solar energy production and discuss the value of such information in urban planning practices.

KEYWORDS: *BUILDING-INTEGRATED PHOTOVOLTAICS (BIPV), SOLAR POTENTIAL, SUSTAINABLE URBAN PLANNING*

PROGRESSIVE ESSENTIALISM: BUILT ENVIRONMENT DEVELOPMENT APPROACHES FOR INCREASING PARTICIPATION IN SUSTAINABLE DEVELOPMENTS AND LIFESTYLES

Dr. Paola Sassi

Oxford Brookes University

Dancing Rabbit community, Missouri USA

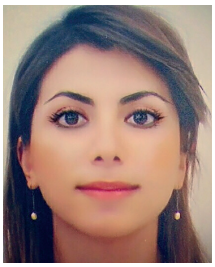
WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Achieving 80% carbon emissions reductions and other radical change required to create sustainable communities cannot be achieved with technology alone. People have to adopt more sustainable lifestyles; however personal change can present a seemingly insurmountable challenge, whether it involves moving or upgrading one's home, changing jobs, becoming vegetarian or giving up one's car.

This research formulates six approaches relevant to the development of the built environment that facilitate and or motivate the change to a more sustainable lifestyle by addressing essential human psychological needs. Findings from thirty-seven in-depth interviews with individuals who joined or were instrumental in developing sustainable communities in the UK, Ireland and the USA, were analysed in relation to human psychology in particular evolutionary, social and behaviour psychology. The term 'essentialism' in the title 'Progressive Essentialism' refers to the fact that these characteristics relate to essential physical and psychological human needs, rather than the needs as perceived through the lenses of a consumerism society. The term 'progressive' suggests a further development to the model of sustainable architecture by integrating these essential human needs. The essential needs identified as having potential to be addressed through the building and building process were grouped into three groups and include: 'Stability and Safety' (Absence of threats and reassurance for the future), 'What Defines Us' (Expressing identity and status, Belonging to a supportive group, Opportunity to lead a meaningful life) and 'Wellbeing' (Inhabiting healthy environments, Ability to enjoy nature). [...]

KEYWORDS: *Sustainability, built environment, psychology of motivation, human needs*



INCLUDING CHILDREN IN POST-OCCUPANCY EVALUATIONS OF NEW AND SUSTAINABLE SCHOOL BUILDINGS

Naghmeh-Pak, Andrea-Wheeler

Iowa State University

A View of one of the classrooms under observation in Pilot School

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Why include children in post-occupancy evaluations? Some of the reasons are that children experience comfort differently to adults; they can have a perspective on the use of space that is different to architects; and can have knowledge of the performance of a building, which is unknown to their teachers. This paper explores the theoretical underpinnings of methodologies, which propose to include the user community perspectives, including children, in post-occupancy evaluations in some projects such as schools. It discusses the overall aims, the employed techniques, and the measured outcomes of such projects, with reference to a pilot research project in a school in Iowa to develop a methodology to explore the level of comfort and satisfaction of the occupants.

KEYWORDS: *Post Occupancy Evaluations, Children, Comfort.*

ANALYSIS OF THREE TYPES OF WINDOW THEIR USE FOR SUBHUMID WARM CLIMATE

Dulce Miramontes Gaspar, Adolfo Gómez Amador, Carlos Escobar del Pozo

University of Colima

Experimental modules, external view.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Natural ventilation is a great opportunity factor for energy saving, a good design and best use of ventilation devices are able to resolve needs of the inhabitants, mainly in warm climates, this research was realized in Colima, México. This article present results of a quasi-experimental study at which the flow rate was analyzed in different window types: two center pivot, casement and louver; the objective was to determine which of these models or window designs provides better performance in capturing airflow rate. Currently, devices are required to improve the effectiveness in ventilation systems, the low cost houses usually have small rooms and spaces and it does not allow the use of cross ventilation and privacy for the inhabitants. Airflow velocity and volume should be increased for the rooms and common areas, therefore, it is important to identify which windows are a better solutions, as they are the main entrance of ventilation in the room houses. For the experiment, it was required use of modules localized in the Faculty of Architecture and Design at the University of Colima, with windows to real scale and environmental conditions of a space open, they were monitored simultaneously with anemometers by 48 hours. The results respond to the environmental conditions of the place, the study collected more than 500 data per device, with which the airflow rate and ventilation rate was calculated. The results suggest which of the three types of windows analyzed is the best option for capturing the airflow, and be a better choice in housing design from warm areas.

KEYWORDS: *Airflow, speed, windows, ventilation, sub-humid, warm climate.*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Knowledge Transfer

2nd Parallel Session

DAY 2

10:30 – 12:30

CHAIRMEN

Pablo La Roche ..... Table 9
Juan Vallejo ..... Table 10

AN INNOVATIVE APPROACH TO BIM CHALLENGES IN FREEFORM ARCHITECTURE

Stefano Mazzer,
Fabio Bellan
Bill McArthur,
Marc Zobec (PhD)

PERMASTEELISA

Managing architectural complexity through a standardised "bim" approach

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Permasteelisa Group is a world-leading Contractor in the engineering, project management, manufacturing and installation of architectural envelopes and interior systems.
Challenges in managing operational activities are identified: number and geographical distribution of offices and factories, configuration complexity and turnkey projects comprising massive data volume, and specific BIM related customer constraints.
The need for knowledge sharing, sharing that knowledge in a global organization, ever changing marketplace pressures and the value of efficiently generating, preserving and sharing huge amounts of information were required.
An improvement philosophy was established; Permasteelisa Moving Forward (PMF), resulting in the development of PMF Project Realization Suite of Tools. Leveraging the capabilities of these software tools, standardized processes were developed including information sharing information with internal procurement and production operations and external stakeholders. Due to unique organizational demands as well as the marketplace, no off-the-shelf tool would suffice.
This paper outlines challenges faced with the increasing configuration complexity of freeform architecture and a strategy developed to manage and utilize information derived from 3D parametric models from the early conceptual design through to procurement, production, installation and life-cycle management of the building and its façade.

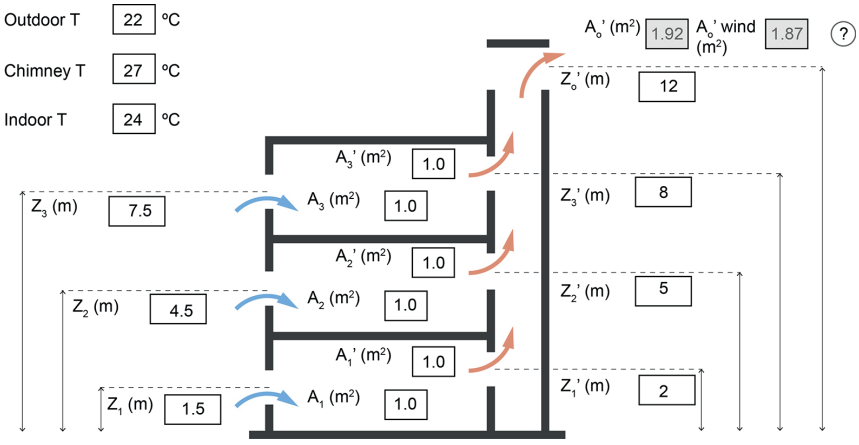
KEYWORDS: *Permasteelisa, Curtain Wall, BIM, façade, PMF, Building*

DESIGNING FOR NATURAL VENTILATION: AN EARLY DESIGN STAGE TOOL

Juan Vallejo, Brian Ford - Natural Cooling Ltd.

Pablo Aparicio Ruiz - Universidad de Sevilla

Camilo Diaz - WSP Group



Natural Ventilation Steady-State Calculation Tool

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Early design stage decision making proceeds very quickly, and strategic decisions regarding the feasibility of natural ventilation must be supported by speedy and reliable evaluation. There are a limited number of such early stage design tools for evaluating natural ventilation options, and none of them are widely used in practice. This paper will present a simple steady-state tool which was initially developed as an in-house tool within a UK based architecture and environmental design practice. The tool has been applied in the development of a wide range of projects, and has proved to be reliable and quick to use in evaluating the broad feasibility of natural ventilation options. It is also an innovative educational tool which has been used widely by post-graduate students in exploring the implications and opportunities for natural ventilation in different locations and for different building types. This tool has recently been further developed for more widespread use and application. The objective was to expand the range of generic airflow strategies that can be explicitly evaluated, extend the geographic applicability of the tool, incorporate a more user-friendly graphic interface, and release it in a web-based platform to be accessible from any device. A comparative evaluation of the attributes of different existing tools, a survey of user experience and a critical evaluation of potential improvements to the detailed structure of the tool, has formed the basis of the further development of this tool. It is envisaged that these developments will make it a more widely used professional tool and facilitate the design and evaluation of proposals for low carbon naturally ventilated buildings worldwide.

KEYWORDS: *NATURAL VENTILATION, SOFTWARE TOOL*

HOW NOT TO 'LIVE YOUR LIFE IN A JUMPER' LEGACY OF HVAC AND THE CURIOUS CASE OF COMFORT IN PASSIVHAUS

Jing Zhao, Kate Carter

University of Edinburgh

1950 Pennsylvania Railroad marketing poster featuring air conditioned cars (Collection, 2015)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

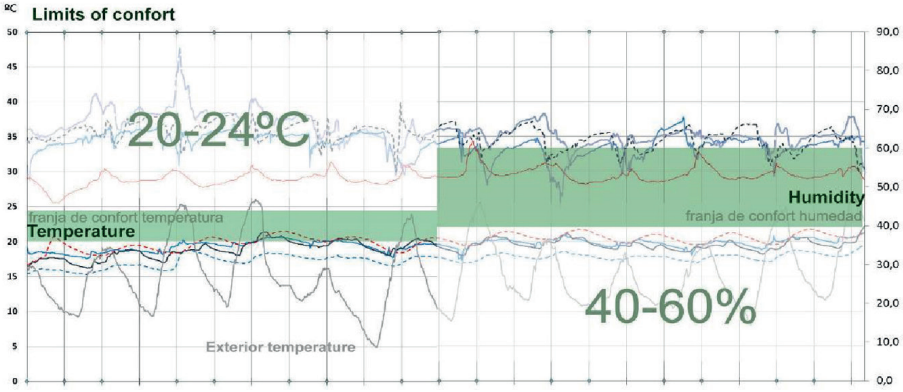
Since the 1970s, the comfort model has experienced a major paradigm shift from PMV/PPD to the 'adaptive comfort' model (de Dear et al., 2013). As opposed to considering buildings as 'environmental capsules' with centrally controlled HVAC (Heating, Ventilation and Air Conditioning), the core concept of adaptive comfort resides in the idea of harmonizing the outdoor and indoor environment with natural ventilation, and to widen the comfort range of the occupants by increasing adaptive opportunities, to achieve comfort with less energy intensive practices. Passivhaus as a new sustainable housing typology shares features of both a naturally ventilated building, and a mechanically controlled building. It is designed on the premise that occupants are to accommodate its passive features, and adapt their perception of comfort into a more sustainable mean. The result however is far from ideal. Case study analysis of a diverse range of Passivhaus projects in the UK, argues that fundamentally Passivhaus principle is against the principle of adaptive comfort. The legacy of half a century's application of HVAC has already changed the occupants' expectations of comfort, which are now based as much on a normality of controlled environment as on seasonal and climatic variations. Many Passivhaus occupants are satisfied with or actively pursuing a narrow-ranged temperature setting (20±1°C) that was promised by Passivhaus system throughout the whole year. Increased sensitivity to temperature change is experienced in a few cases, which seems to affect the occupants' demand for a rigid comfort zone in other scenarios. The study also shows the Passivhaus system is in danger of engaging more energy intensive technology for cooling with the escalation of global warming. To re-accommodate the adaptive comfort into the Passivhaus system, more attention needs to be paid from an architectural perspective rather than relying on spread sheet calculation and mechanical solutions.

KEYWORDS: *Passivhaus, adaptive comfort, HVAC*

DRAWING THE PULSE OF ENERGY POVERTY IN NORTH OF SPAIN IN THE 50-80S BUILDING STOCK

Jorge San Miguel Bellod, Ana Sánchez Ostiz,
Ana Castillejo Celigueta, Purificación González M.

School of Architecture UNAV (Spain)



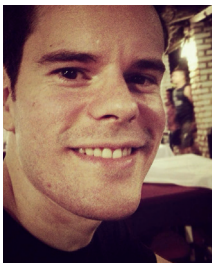
Temperature and Humidity Energy Poverty analysis

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Current definitions of energy poverty do not stablish and effective basement for future solutions in an small-scale context. Detection related to current indicators do not widely define causes affecting families in energy poverty and as a result, do not effectively orientate economic financial support towards real causes. Main (R) SOLUTION offered in this paper to the architectural challenges of the moment is a qualitative analysis of a typical medium-low class building context from the 60s in the north of Spain (Pamplona). This paper draws attention to the importance of examining in greater depth the issues related to energy poverty in a qualitative scale analysis in different areas. Can we conclude that familiar characteristics, from an economical, social, or human based performance point of view are a critical factor influencing "family energy efficiency" (ability to transform economical resources in comfort). In particular, energy consumption is linked to a complex relationship between families and chosen or available energy systems. A fundamental connection, on which it is possible to structure the main causes and impacts on families towards a risk-based analysis in a local scale. Deepening and enlarging the causes and impacts of energy poverty, is a fundamental research to define new risk measurable indicators in the definition of a new methodological approach to embrace effective solutions. Combined strategies ranging not only from economical subsidies but also dedicated to multiple scale retrofitting solutions, or new educative plans to tackle this multidimensional challenge.

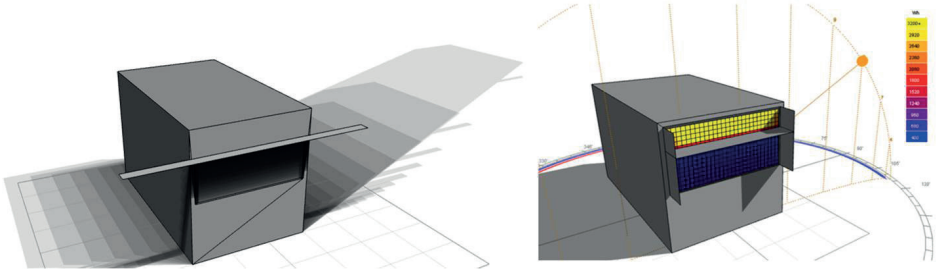
KEYWORDS: *Energy poverty indicators, temperature analysis, human-based performance*



SHADE AND DAYLIGHT: SIMULATED PERFORMANCE OF TYPICAL AND HYPOTHETICAL SHADING DEVICES ON THE UFCG CAMPUS, BRAZIL

Raoni Venancio, Pollyanna Padre

UFCG



Examples of shading performance evaluation.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

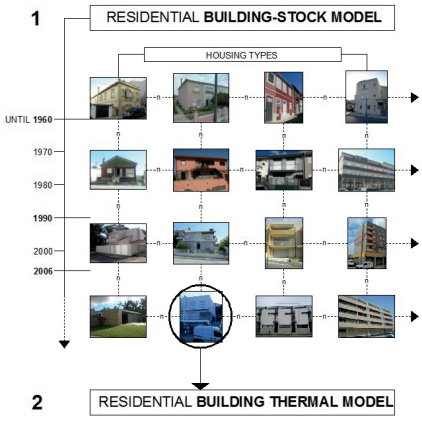
This paper confronts two design strategies that can be conflicting between each other: the need to shade windows and, through its glazed surface, allow acceptable daylight incidence. A responsible design of shading devices can produce many benefits in building performance. By blocking direct solar heat gains, cooling loads are reduced and thermal comfort is easier to achieve. Since direct light is obstructed, the occurrences of glare and high contrasts are also diminished. Also, properly sized shading devices should not block daylight, which can lower the use of artificial lighting. The research focuses on the performance evaluation of typical shading devices (found on the UFCG Campus) and hypothetical (geometrically modified to improve performance). We believe that the primary goal of Architectural Education is to transform architectural practice, much more than the other way around. Therefore, we believe that universities should have the responsibility to apply in practice the recommendations and concepts that are taught in theory. However, we observe that the majority of buildings on our campus have critical performance issues. In order to provide support to future projects on the campus, this work evaluates the performance of shading devices on the UFCG Campus. We adopted simulation tools to assess shading efficiency and daylight levels. In the first simulation stage, shading devices and windows were grouped in types. Shading performance was calculated in Autodesk Ecotect using sun path diagrams and gradient shadow masks. The analysis of results led to the proposition of hypothetical solutions, which development process was based on the needs and requirements to improve the performance of typical shading devices. Only the cases that met predefined performance criteria were investigated further in the second stage, which focuses on daylight performance. We selected Dialux tool to evaluate daylight performance and to test hypothetical cases with reflective surfaces.

KEYWORDS: *Shading devices, shading, daylight, simulation*

DEVELOPMENT OF A HIGH-GRANULARITY STOCK MODEL FOR THE ENERGY DEMAND OF NORTHERN PORTUGAL RESIDENTIAL BUILDINGS

Ana Ferreira
INEGI

Vitor Manuel da Silva Leal, Eduardo de Oliveira Fernandes
INEGI - Institute of Sience and Innovation in Mechanical and Industrial Engineering



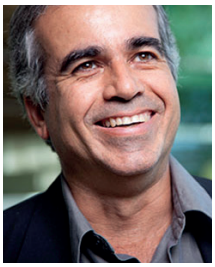
Building stock model representation for energy needs calculation

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Buildings are a prominent sector for addressing energy use, comfort and health. Currently, there is a gap regarding the knowledge of physical characteristics of the building stock and its retrofit needs which, together with lack of information on energy performance and use by building owners and occupants urges for a better understanding of the sector, especially the residential subsector. The goal of this study is to analyse residential buildings in a regional, local perspective, as the characteristics of each region are considered as likely influential of building performance. This work will lead to an extended knowledge on the residential building stock from Northern Portugal region by defining a methodology for the assessment of energy needs, with a calculation tool based on a bottom-up analysis for large-scale energy modelling of building stocks. The methodology applied consists of a detailed bottom-up analysis of geometric and thermal characteristics of the building stock, allowing for the definition of building types based on average values from the Portuguese Energy Agency database. The defined building types are then quantified to match the total number of residential buildings in Northern Portugal based on surveys from the National Institute of Statistics. This allows for the calculation of average values for energy needs, and also, based on the number of buildings for each building type, a realistic estimation of energy needs for the whole building-stock, for this specific region.

KEYWORDS: *Energy needs; Building stock; Residential buildings*



TEACHING SUSTAINABLE ARCHITECTURE IN A CHANGING CLIMATE

Pablo La Roche

California State Polytechnic University Pomona

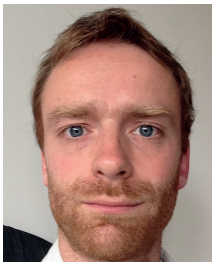
Sustainable Systems in Community Center, Cerro Azul, Mexico

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The path to sustainable architecture is affected by social, cultural, economic and environmental factors. However, instead of developing alternative solutions, most of the current research has focused on improving established technologies such as HVAC systems. Societies with simpler architectural technologies offer opportunities to introduce alternative systems different from established ones in developed countries. Instead of using cheaper more inefficient versions of systems when more efficient but more expensive versions are out of reach, it is possible to develop alternative paths to those of developed countries. This paper deals with the intersection of two important strategies in this area: a) appropriate education for today's environmental challenges and b) the development of sustainable and socially responsible architecture. This is accomplished through a combination of hands-on design studios and seminars that also help communities in need. The students in the studios design the projects to a conceptual level, while the students in the seminars continue developing the design, but also build and test passive and active systems that are proposed in the initial designs. These low cost sustainable systems can improve building performance and reduce their environmental impact, while contributing to develop a contemporary architecture that maintains traditional values and is respectful of its environment. It is important to develop solutions to these very real problems that at the same time contribute to the development of a contemporary architecture that preserves traditional values and is respectful of its environment.

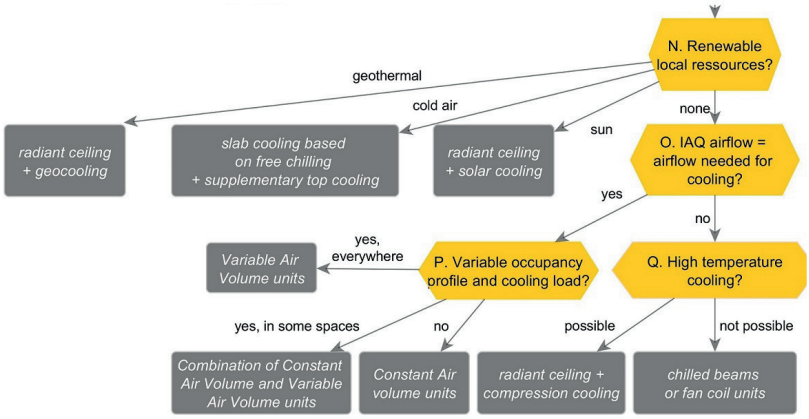
KEYWORDS: *LOW COST SUSTAINABLE ARCHITECTURE AND SYSTEMS, PASSIVE COOLING*



A DECISION TREE FOR AN INTEGRATED COOLING DESIGN : OCCUPANT+ARCHITECTURE+HVAC

Geoffry van Moeseke, Olivier Dartevelle

Université catholique de Louvain



Detail of one fork of the proposed decision tree

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

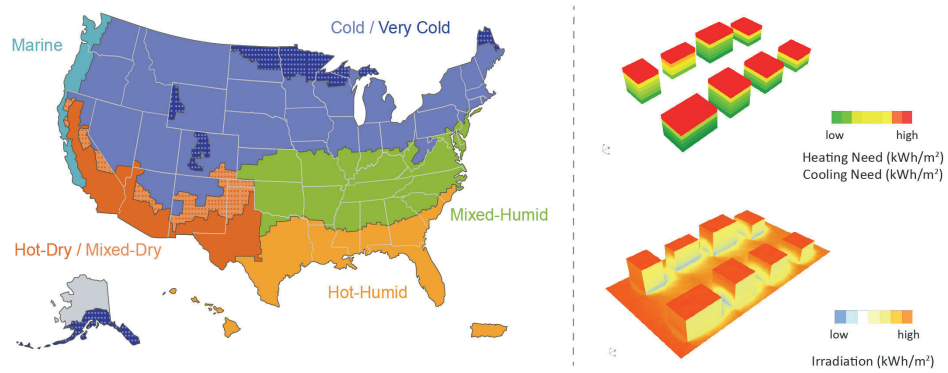
Building design should be done in an integrated way between architectural and engineering firms in order to identify technically and economically optimal solutions. Also, energy efficiency is more easily reached when considered as the starting point of the design, and when the specificities of the occupant's profile are considered. To do so, designers need dedicated tools to guide the design and promote understanding between stakeholders.

The proposed decision tree helps designers identify adequate cooling systems based on the occupant's profile, buildings characteristics and locally available resources. Cooling systems are presented ranked according to their intrinsic energy efficiency. This decision tree could be used prior to detailed thermal simulations in order to impact the design at preliminary stages.

KEYWORDS: *Cooling, HVAC, decision tree, occupant*

THE SENSITIVITY OF PREDICTED ENERGY USE TO URBAN GEOMETRICAL FACTORS IN VARIOUS CLIMATES

Emilie Nault, Parag Rastogi - Interdisciplinary Laboratory of Performance-Integrated Design (LIPID), Ecole polytechnique fédérale de Lausanne (EPFL), Switzerland.
Emmanuel Rey - Laboratory of Architecture and Sustainable Technologies (LAST), EPFL
Marilyne Andersen - LIPID, EPFL



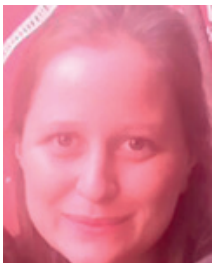
Heating need per floor in an early neighbourhood design

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Urban morphology, including building typology and layout, has a significant influence on the built environment's access to the sun, which impacts its energy exchange with the environment. This energy exchange is a strong factor in determining the comfort levels of occupants in buildings and the energy consumed to reach comfort. The influence of urban form has been quantified in previous studies for certain building typologies and programs for specific climates (i.e. location-specific case studies). We are interested in taking this further to assess the variation, due to climate, of the influence of different urban forms on the urban energy balance. This is part of a larger project to study the interaction between form and climate vis-à-vis energy and comfort in buildings. In this paper, we explore this issue through simulation, in various climates, of 3D neighbourhood models. These models consist of a series of parametrically generated variations on building typologies like block, L-shaped, and courtyard block. Each neighbourhood alternative is described through a set of geometrical parameters including the form factor, window-to-floor and plot ratio. We used an extensive database of heating and cooling uses generated by simulating each variant in a representative set of climates to assess the sensitivity of energy use to the geometrical descriptors and climate types. This is done using a regression equation whose input parameters are easily calculable, e.g. form factor, and whose output is an estimate of simulated energy use. The aim of exploring this relationship is to use it to assess the suitability of different urban forms in a given climatic context. Moreover, it provides a promising route to avoid the necessity of detailed energy simulations in comparing the performance of different early urban design alternatives.

KEYWORDS: *CLIMATE, NEIGHBOURHOOD-SCALE, EARLY-DESIGN PHASE, BUILDING TYPOLOGY, ENERGY PERFORMANCE*



DEVELOPING AN ENERGY EFFICIENCY ASSESSMENT TOOL FOR BUILDINGS ACCORDING TO USER BEHAVIOUR INDOORS

Alción Alonso Frank, Ernesto Kuchen, Yesica Alamino Naranjo

Regional Institute of Planning and Habitat, IRPHa. National University of San Juan, Argentina

Identification of user efficiency level. Example for UEL=4

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Efficient energy use is the most effective measure towards significantly reducing greenhouse gas emissions in order to improve the levels of environmental sustainability, and to guarantee the energy supply as a resource for social development. The behaviour of the energy user may seriously affect the running costs of the building, therefore, the user must be considered as an economic variable in the balance of running costs of the building. The purpose of this paper is to develop a tool for assessing how much influence the user has on energy efficiency, considering habits of energy use during the adaptation process of their comfort condition. To achieve this, three buildings with standard spaces are taken into account, users are surveyed and sensor measurements are performed at different periods in the year. Various actions are analyzed as regards the use of air conditioning devices, the opening of doors and windows, control of sunshade and curtains, and clothing modification, among others. The user habit actions are weighted into categories (good/bad) and they are divided into ranges to determine the degree of energy efficiency of the user. Results show that the user is responsible for a 33% decrease in the efficiency level that the building may reach. It is concluded that the use of the tool has a significant importance since it would not only allow obtaining relevant information for measuring rational use of energy, but also serve as an awareness and rationalization instrument for users indoors.

KEYWORDS: *ENERGY MONITORING, USER BEHAVIOUR, RUE*

AS-BUILT PERFORMANCE EVALUATION OF A PREFABRICATED LOW-ENERGY TIMBER DWELLING: THE NOTTINGHAM H.O.U.S.E.

Vasileios Sougkakis, Lucelia Rodrigues, Mark Gillott, Renata Tubelo

The University of Nottingham

The Nottingham H.O.U.S.E.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

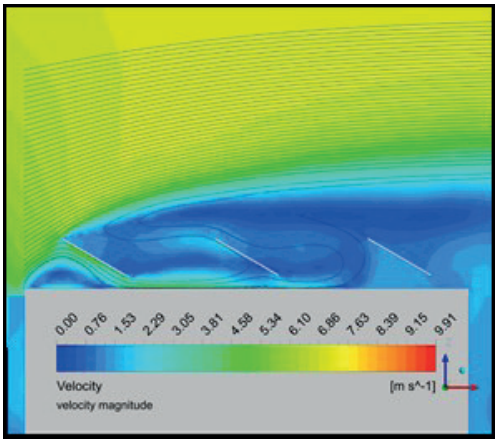
As a result of a projected housing shortage and the environmental policy, the housing industry in England is facing two major challenges. It is required to provide large volumes of affordable housing built to excellent quality and energy efficiency standards and off-site construction is expected to play a significant role. This building method is considered advantageous in terms of construction speed and quality when compared to traditional methods. However, the so-called performance gap, the difference between the as-designed and as-built performance, is an issue of concern whatever the construction method. In this work, which is presented for the first time and builds upon previous simulation work on the house performance, the authors have assessed the as-built performance of an off-site manufactured house designed as a starter house for a new family, addressing the projected change in the average UK household size. The building is conceptually a solution for quality mass produced affordable low-energy housing and it incorporates the characteristics of modular construction and zero-carbon design. The assessment included the use of various methods such as co-heating test, ambient temperature monitoring, airtightness test, in-situ U-value measurement and recording of heat flows through the various building elements and thermal imaging survey. The as-built performance was compared against the designed performance in order to identify areas where construction did not meet design criteria. The novelty lies on the fact that in practice it is extremely hard to undertake such a comprehensive study at this level of forensic scrutiny, which was only possible due to the house being built as part of a research project and adds further evidence to a growing field of research. [...]

KEYWORDS: *Performance gap, Zero carbon housing, Housing shortage*

THE INFLUENCE OF PHOTOVOLTAICS ON ROOF THERMAL PERFORMANCE - AN ANALYSIS OF CONVECTIVE HEAT TRANSFER COEFFICIENTS

Daniel Micallef, Vincent Buhagiar, Simon Paul Borg

University of Malta



Flow streamlines and velocity magnitude contours over a flat roof having three rows of photovoltaic panels. Wind speed at inlet and at the building height is 6m/s.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In a Mediterranean climate, given the absence of snow, flat roofs are typical of both vernacular and modern architecture. Thermal mass, cross ventilation and night time cooling are standard passive design aids that inhibit indoor temperature build-up on hot summer days. Such flat roofs provide a golden opportunity for free-orientation of PV (photovoltaic) panels, unlike pitched roofs.

There is established scientific evidence that their presence on flat roofs also helps curtail surface temperatures of the heavy mass structure, by means of (i) solar shading and (ii) convective cooling at given angles. Both factors in turn lower the convective heat transfer coefficient (CHTC) of the roof structure, thus inhibiting early seasonal temperature build-up. This contributes to lower cooling loads, thus reducing both the carbon footprint of the building as well as lowering energy costs for the owners. Such a holistic contribution is deemed to uphold the social, environmental and economic challenges of today. This study purports to do just that. Through CFD (computational fluid dynamics) this study investigates the effect of flow fields over a typical flat roof building mass in a free field for a range of wind velocities. Results indicate that for a higher wind speed, the convective cooling is more significant than at lower wind speeds. This will in turn influence the elemental U-value of the roof structure, thus reducing cooling loads indoors.

KEYWORDS: *PASSIVE SOLAR DESIGN; CONVECTIVE HEAT LOSS; CFD (COMPUTATIONAL FLUID DYNAMICS); CHTC (CONVECTIVE HEAT TRANSFER COEFFICIENT)*

ENERGY BEHAVIOUR IN A SOCIO-CULTURALLY DIVERSE HOUSING AREA IN MALMÖ, SWEDEN

Laura Liuke, Erik Johansson
HDM, Lund University

Eja Pedersen
Environmental Psychology Group, Lund University

Public rental housing in Malmö

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Energy behaviour relates not only to the general level of information available but is largely based on the socio-economic and cultural context including factors such as cultural behaviour, household size and composition, income and education levels as well as knowledge and awareness regarding energy use. The individual standpoints influencing behaviour result from all the previous factors. This study investigates differences in energy behaviour of households with varying socio-cultural backgrounds in Malmö, Sweden. With 31% of the Malmö population born in countries other than Sweden the current energy behaviour of its inhabitants can be assumed to be influenced by the households' varying socio-cultural background. The study consists of two steps: short questionnaires in a population sample, followed up with semi-structured interviews among a limited number of households focusing on the every-day life-style and energy-use patterns. The pilot study questionnaire results point at relatively equal level of environmental concern among the respondents regardless of their background whereas the belief in one's own possibilities to influence environmental mitigations are higher among those having resided in Sweden for a long time. The forthcoming results of this PhD study will assist in planning for resilience by developing tools for communication and training of sustainable methods and related skills for reduced household energy use both in the context of urban regeneration and development of new building typologies for the urban mixed-income population.

KEYWORDS: *Energy behaviour, household energy use, environmental concern*

ASSESSMENT OF LIFE-CYCLE ENERGY AND CO_2 EMISSIONS FOR RESIDENTIAL BUILDINGS IN MAJOR CITIES OF INDONESIA

Dr. Eng. Usep Surahman

Universitas Pendidikan Indonesia

Individual unplanned residential buildings in Indonesia

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The objective of this study is to analyse life cycle energy and CO2 emissions profiles by employing an input-output analysis method for urban houses in major cities of Indonesia. Two surveys investigating building material inventory and household energy consumption within unplanned houses were conducted in Bandung (n=247) and Jakarta (n=297) in 2011 and 2012. The results show that the averaged embodied energy for simple (66.4 GJ), medium (236.2 GJ) and luxurious (866.5 GJ) houses in Bandung was larger than that for houses in Jakarta (58.5, 200.9, 559.5 GJ) respectively. Overall, the average annual energy consumption of all samples in Jakarta was approximately 44.2 GJ, which is 14.9 GJ larger than that in Bandung. In life cycle energy, the operational energy accounted for 87%-91% and 76%-86% of the total for respective houses in Jakarta and Bandung. The profiles of life cycle CO2 emissions are similar to those of energy. The results of the scenario analysis prove that the promotion of reuse/recycling is important to reduce building material inputs/waste and their corresponding embodied energy. It is also important to reduce the use of air-conditioning in the future by adopting passive cooling techniques wherever possible.

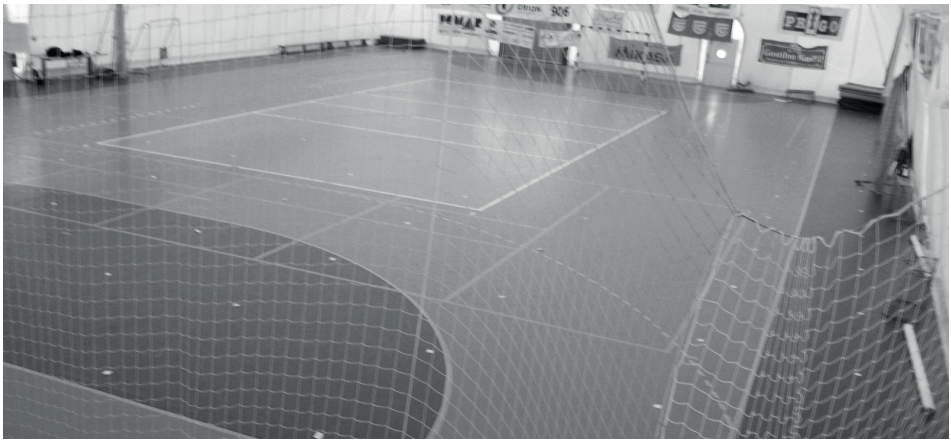
KEYWORDS: *Life cycle assessment, Embodied energy, Household energy consumption, Input-output.*

DAYLIGHTING OF AIR-SUPPORTED STRUCTURES . A CASE STUDY

Grega Zrim - CARD Energy Efficient Concepts d.o.o.

Aleš Krainer - Institute of Food Safety and Environmental Health

Živa Kristl - BiroArcus d.o.o.



Indoors of study case air-supported dome at Brezovica

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

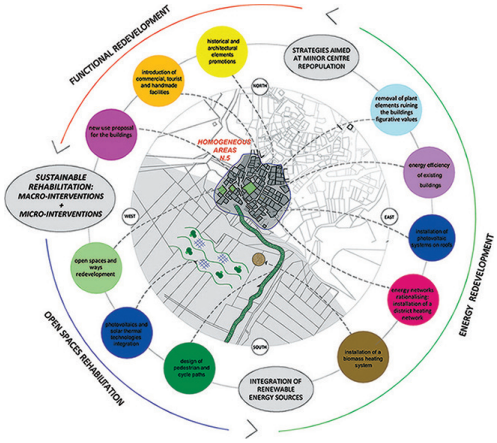
Air-supported structures have been recognised as an alternative to conventional buildings for commercial usages, more often at sport facilities, warehouses and the covers of various venues. Lightweight membrane structures using translucent skin enable daylighting without specific windows but within the perspective of today's demands for energy efficiency and at the same time accessible technologies, the considered building typology may not perform to its best potential. The goal of this research work was to form a valid approach to the daylighting simulations of double membrane translucent skins and to obtain an understanding of their quality. The work was segmented into three parts, in situ illuminance measurements at a study-case building for obtaining reference data, outdoor spectrometry for obtaining the luminous properties of the membranes and a set of daylighting calculations executed with DAYSIM to test various simulation approaches. The outcomes of the field work indicate that the daylight factor is uniform but low. Thus the need for sound comprehension of simulation work is necessary in order to achieve sufficient accuracy for evaluating aerogel blanket implementation. Initial runs have confirmed that the model of a double membrane envelope with parallel faces may be used at a small loss of accuracy but further simplification to single layer model is not recommended. Finally, a comparison between the average values of the daylight factors, obtained by the two methods, shows considerable differences. The differences can be explained by overrated light transmittance of the membranes and the fact that the indoor obstacles were not modelled.

KEYWORDS: *DAYLIGHTING, AIR-SUPPORTED STRUCTURES, DAYLIGHTING COMPUTER SIMULATIONS*

NEW ENERGY SOURCES FOR THE SMALL HISTORIC CENTRES IN (R)EVOLUTION

Chiara Marchionni, Pierluigi De Berardinis

University of Study of L'Aquila



Mix of micro interventions for the design area, Fontecchio (AQ).

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The research links the issue of recovery of historic built heritage to the environmental issue, proposing the energetic rehabilitation as opportunity to carry out a virtuous action in the territory.

The work starts from the rediscovery of the peculiarities, environmental and economic of an area for years in abandonment, like the inner area of Abruzzo Region affected by the earthquake of April 6, 2009. The research considers the small centre as an ecosystem, where there is a goal of adaptation to pursue, to satisfy functions and standard of comfort changes.

In this way, the work aims to provide an operational methodology to the sustainable redevelopment of towns, focusing on the possibility of renewable energy sources integration and on the topic of energy networks. In such weak contexts, in fact, are evaluated the compatibility and the possibility of application of renewable energy sources, considering the off-grid technological systems too, through the applications of micro interventions.

The aim is to identify site specifics for their localization, places that can become energy islands respecting built heritage, to promote the re-population of the small centres.

The development of the compatibility process began the basis for the next phase of the research, which aims to evaluate the quantitative results of the proposed technologies on a case study, the minor centre of Fontecchio (AQ).

KEYWORDS: *REHABILITATION, MINOR HISTORIC CENTRES, RENEWABLE ENERGY SOURCES, COMPATIBILITY.*

THE NEED FOR ARCHITECTURAL MATERIALISM

Thanos N. Stasinopoulos

Izmir University of Economics, Turkey

An exposed swimming pool in a windswept setting. Wind gusts could easily blow the water away

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Physical reality is directly related to sustainability. Lately a new, virtual, reality has been brought by the ongoing digital explosion, with its matching virtual architecture in cyber space where sustainability is an irrelevant notion. This paper points to that trend and its negative side effects, summarizing concerns on the urgent need to reinstate the materiality of architecture and her bygone dependence on nature and its laws. It underlines the necessity to address that challenge in a systematic way, advocating an architectural attitude that can promote sustainability in practice end education. The effort should primarily focus on the videogames generations that have grown up in digital fantasy lands rather than in nature, forcing certain amendments of architecture education.

KEYWORDS: *Materialism, sustainability, virtual reality, architecture education, digital design*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

Knowledge Transfer

3rd Parallel Session

DAY 2

14:00 – 16:00

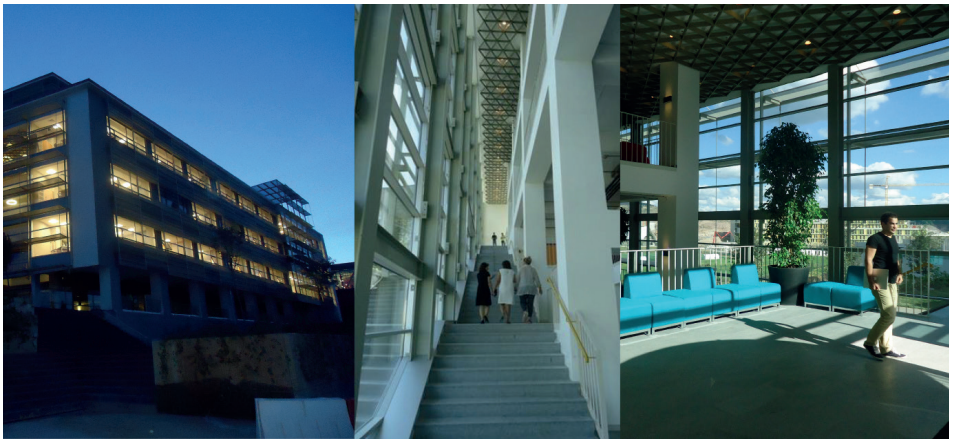
CHAIRMEN

Paula Cadima ..... Table 9
Alessandro Speccher ..... Table 10

THE "ENERGY-EFFICIENCY-CORE" CONCEPT FOR A NEW BUILDING

Yasemin Somuncu
Architect, CEEE, Özyeğin University

M. Pınar Mengüç
Director, CEEE, Özyeğin University



External and internal views of SCOLA Building

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

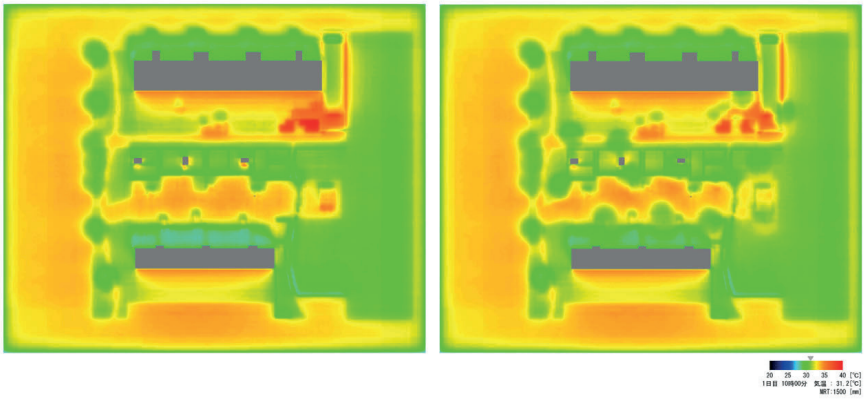
In this paper, we present a case study to show the importance of the "Energy-Efficiency-Core" (EEC) concept for the design, construction and operation of new buildings. We combined the EEC with an extended "Integrated Project Delivery" (IPD) wheel concept (EEC-IPDW, for short), which is shown to be an effective approach to enable the key design principles to be carried on from the time of inception of a building to its daily operation at the end. Implementation of EEC-IPDW is shown to improve the long term cost of building design, construction, and operation through an intelligent facility management procedure. It is also shown that EEC-IPDW helps to prevent any adverse and unexpected interference from the specialized stakeholders, who, after joining the building at a later phase, suggest changes over the original concepts, including architectural beauty, aesthetics, and the coherent use of the building-integrated technologies. In addition, EEC-IPDW helps to the implementation of the innovative financing of buildings to secure its sustainable construction and operation, beyond the traditional construction phases. In this paper, the EEC-IPDW is explained based on the experiences gained from an on-going EU-FP7 project, NEED4B (New Energy Efficiency Demonstrations for Buildings). The Turkish demonstration site, School of Foreign Languages (SCOLA) has been designed, constructed and is being operated by implementation of EEC-IPDW. In this specific case, the EEC is administered by the Center for Energy Economy and Environment of the Özyeğin University. An architectural firm, engineering firms, a construction company and several EU-based centers were involved in decision making processes.

KEYWORDS: *Energy-Efficiency-Core (EEC), Extended Integrated Project Delivery Wheel (IPDW), Energy Efficiency*

MASS HOUSING REVITALIZATION THROUGH PUBLIC SPACE – SOCIAL AND PHYSICAL POTENTIAL OF OPEN SPACES

Bruna Bajramovic, Yuichiro Kodama

Kobe Design University



MRT map (green 30°C, red 40°C) at 10am on a hot summer day, before (L) and after(R) of the redesign of the thermal environment based on the observed use of open spaces

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Since 2004, the population of Japan has been decreasing which implies further rise in underused existing building stock. Under the influence of the population trends, there have been movements toward the renovation of existing building stock versus the tatekae (scrap and build method). So far, the potential that the outside public spaces of the mass housing developments have in their revitalisation have been fairly neglected. This paper goes to show the potential of public spaces in the process of the revitalization of the mass housing developments, from the social and physical environment stand point based on the study of the Tamamusubi Terrace Apartment Building Complex renovation project. It represents a trail model of a possible new trend in renovation of mass housing developments. Social components, the activities residents engage in, in the open spaces, have been observed in the summer and winter seasons. The physical environment's potential is examined through observations of the environmental conditions of the open spaces in deferent scenarios, summer and winter throughout the day. Also computer simulated scenarios further deepened the understanding of the environmental potential of the chosen study space.

By layering and comparing the different aspects of this case study, a more comprehensive use of the open spaces of mass housing complexes can be recognized and utilized in the process of the revitalization.

KEYWORDS: *APARTMENT COMPLEX REVITALIZATION, THERMAL ENVIRONMENT, OPEN SPACE USE, COMPUTER SIMULATED THERMAL ENVIRONMENT*

MIGRANT CENTRE AND PRIMARY SCHOOL IN LAMPEDUSA (IT)

Andrea Rossi, Pierluigi Turco, Simos Yannas

Architectural Association, Sustainable Environmental Design

Migrant centre and primary school - main entrance

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The island of Lampedusa has been the main gateway to Europe for thousands of African and Middle-East migrants seeking asylum. Current national and international policies have aimed to deal with this phenomenon by containing the refugees in detention centres that are separated from the local community. This has led to social tension. The research project presented in this paper was driven by humanitarian considerations and informed by the seasonality of migrant arrivals and the climate of the island. The proposal is for a new migrant centre and primary school offering facilities that can be shared with the local community. The design draws upon on-site fieldwork and is informed by extensive use of computational tools for solar, thermal, daylight and airflow simulation to ensure that comfortable environmental conditions can be achieved indoors and outdoors. The accommodation is organised under an adjustable linear canopy that is open to the sky and runs along the full length of the scheme. Adjustments to the sky view of the canopy allows control of incoming solar radiation over the daily cycle as well as seasonally and offers wind protection when needed. The spaces under the canopy can host a range of outdoor and semi-outdoor activities. The construction of the scheme relies on local materials: the timber recycled from the migrants' abandoned boats together with local stone and the posidonia collected on the island's beaches that can be compressed to provide thermal insulation for external walls and roofs. Construction costs are estimated to be reduced by over 60% and the scheme offers opportunities to employ traditional local craftsmanship.

KEYWORDS: *MIGRATION, PASSIVE COOLING, SOLAR CONTROL, ADAPTIVE ARCHITECTURE, LOCAL RESOURCES.*

EVOLUTIONARY OPTIMIZATION PROCESSES AS DESIGN TOOLS: IMPLEMENTATION OF A REVOLUTIONARY SWARM APPROACH

Judyta Cichocka
Wroclaw University of Technology

Will Browne, Edgar Rodriguez
Victoria University of Wellington

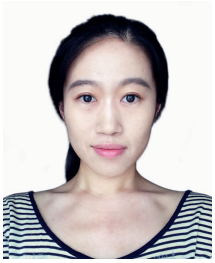
Optimization processes in Particle Swarm Optimization: particles and their current velocities.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Building sustainable and resilient lives in harmony with the ecosystems and local resources requires a bottom up approach as it starts from the analysis of people needs and social-economic trends. Most current social, environmental and economic challenges have multiple features, such as changes in people lifestyles, urban growth, energy and water expenditures, affordability and quality of living conditions. In order to rationalize these features, complex problem analysis and optimization tools are introduced into the design process. Evolutionary Computation (EC) techniques are considered to be suitable in solving most design problems (Kicinger et al., 2005). However EC solvers are slow (Rutten, 2010), unintuitive, hard to visualize and not verified (Vierlinger, 2013), therefore they are not widely adopted, resulting in many valuable design opportunities being missed. This paper visualizes how biological optimization techniques can assist with architectural design problems. Furthermore, a Swarm Intelligence (SI) approach is introduced as it is hypothesised to be fast, easy to tune and intuitive in its operation. The most popular platform for parametric modelling - Grasshopper® plug-in for Rhinoceros 3D® (Martyn, 2009) was selected as the demonstrator. Experimental results on four domains of increasing complexity show the effects of diversification in the mapping processes of solvers. The introduced Particle Swarm Optimisation (PSO) technique, which relies on SI rather than EC, demonstrated its computational speed, intuitiveness and robustness in complex optimization problems. Such problems increasingly occur in modern architectural practice, so PSO has the potential to become a revolutionary design tool.

KEYWORDS: *EVOLUTIONARY COMPUTATION, OPTIMIZATION, PARAMETRIC DESIGN, PARTICLE SWARM OPTIMIZATION*



A STUDY OF PASSIVE DESIGN STRATEGIES FOR COURTYARDS OF THE OUTPATIENT DEPARTMENT IN HOSPITAL BUILDINGS IN COLD REGIONS

Yizhao Sun, Qiong Huang, Anxiao Zhang, Qi Zhang

Tianjin University

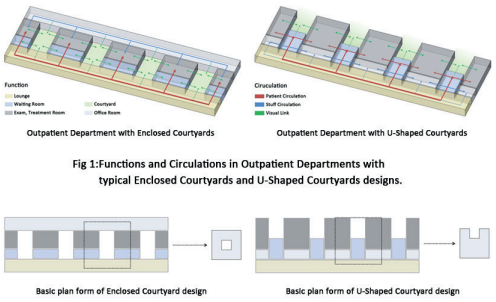


Fig 1:Functions and Circulations in Outpatient Departments with typical Enclosed Courtyards and U-Shaped Courtyards designs.

Fig 2:Plans of two basic forms resulting from the two typical courtyard designs

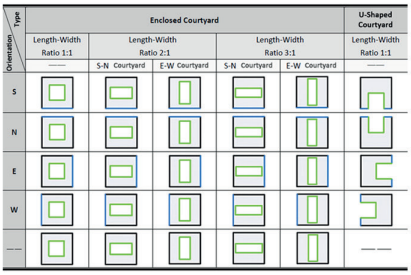


Fig 3:Prototypes of analysed courtyards in this research. Including different positions, LWR, orientations of courtyards, and different orientations of the outpatient department.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper aims to explore effective passive design strategies for courtyards in the outpatient department for a better medical environment and lower energy consumption. The investigation of existing outpatient departments in Tianjin focused on the physical environment and space-design methods. The investigated data showed that air temperature, wind speed and illumination varied depending on the organization of the plan layout and specific space forms, especially, were influenced by the designs of courtyards. The investigation and literature indicated that the courtyards' positions (including enclosed courtyards and U-shaped courtyards), the dimensions (especially the length-width ratio), and the orientations were the determinative factors in impacting the energy consumption level and physical environment.

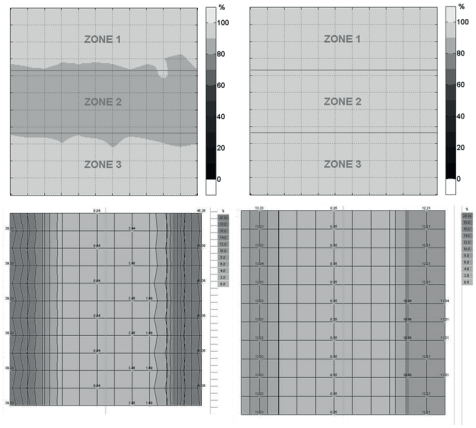
To clarify the relationship of the courtyard-design, energy consumption and the physical environment, two standard models (including enclosed courtyard and U-shaped courtyard) were built up to compare their energy consumption (heating, cooling and lighting), daylight and their ventilation environment. For further analysis, the building orientation and courtyards' length-width ratio were added as factors to be studied. The results of simulations showed that: (1) the U-shaped courtyard provided better daylight conditions, with lower annual energy consumption compared to the enclosed courtyard; (2) The length-width ratio of the courtyard did not have a direct impact on daylight and ventilation performance, but did have a clear impact on the level of energy consumption; (3) both the orientations of the outpatient building and courtyard were major factors in affecting the performance of energy consumption, daylight and natural ventilation.

KEYWORDS: *Courtyard, Outpatient Department, Energy Consumption, Daylight, Ventilation*

CHALLENGING SOLAR DESIGN CLICHÉS - SOLAR CONTROL STRATEGIES

Yogeshwar Gooljar

PJ Carew Consulting



Comparative analysis of vertical vs horizontal louvres

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper challenges the clichés around solar control design and orientation. It proposes an analytical approach according to building typology, building geometry, orientation and location based on latitude. The approach considers not only solar control performance, but availability of external views, glare control and daylight availability with related lighting energy consumption. The variation in daylight availability, significant difference in sun path and the added performance indicators demonstrate that using the typical cliché's of vertical shading on East and West facades can send designers off on significant tangents. The paper compares vertical shading on an east and west facade with horizontal shading with the same shading surface area to demonstrate applicability and potential inapplicability with reasoning why the cliché is suited to certain conditions (or not) and not to others. The paper concludes with a summary of the results of the different strategies with quantified results in energy performance, daylight availability, access to views and duration of glare limitation as a starting point for designers to appreciate what should be considered in their projects.

KEYWORDS: *SHADING, DAYLIGHT, ENERGY, SUN ANGLE, INSOLATION, ORIENTATION*

GREENING EXISTING SCHOOL FACILITIES: POE RESULTS FOR AN HIGH SCHOOL

Elisa Sirombo, Marco Filippi

Department of Energy, Politecnico di Torino

The high school Maxwell in Nichelino (Italy)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The EU policy framework about sustainable development clearly addresses the public sector as frontrunner in developing innovative approaches for the sustainable management of existing building stock. New ways to promote the implementation of greening processes of existing facilities have to be developed considering the actual scarcity of economic resources.

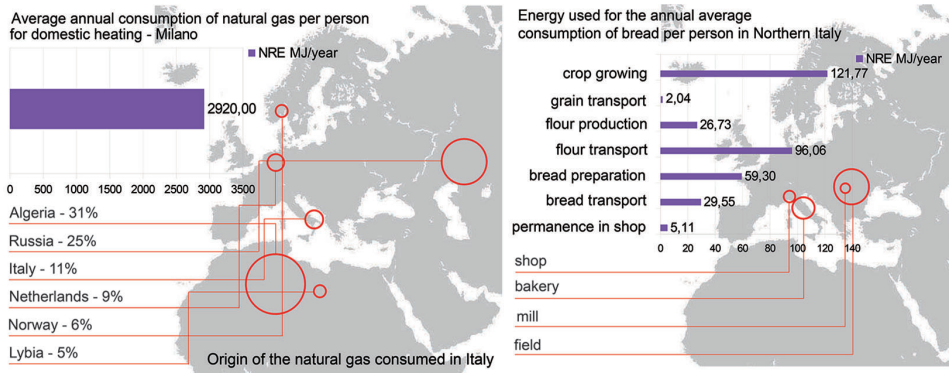
The paper introduces the on-going research project called "Green School", promoted by Politecnico di Torino in cooperation with the Province of Turin, which aims to facilitate the transformation of existing school buildings in sustainable school facilities. As part of this research, a green audit procedure is developed, intended as a systematic method to have a comprehensive understanding of the building considering its performances and users' interrelations and satisfaction, to identify and quantify the implementation of cost-effective sustainability measures and to report the findings. The audit procedure is based on two operating level (basic and diagnosis) and follows the sustainability framework proposed in the EN 15643. The basic level is a low cost screening audit of the performance of a building, which aims to easy analyse a large set of buildings. It is based on the post-occupancy evaluation methods, assessing both indoor environmental quality and building energy performance as well as more subjective and interactional aspects (space use, user satisfaction, etc.) by means of bills analysis, walk-through evaluations and survey to occupants. The paper discusses the results of the implementation of the basic level audit to one case study, the high school Maxwell in Nichelino, where a group of 150 students within the school has been involved with occupant questionnaires. [...]

KEYWORDS: *GREEN AUDIT, SUSTAINABILITY ASSESSMENT, POST-OCCUPANCY EVALUATION, SCHOOL FACILITIES, OCCUPANT*

SIMBIOPOLI: A TOOL TO MAKE COMMON PEOPLE AWARE OF SUSTAINABLE LOCAL LAND USE

Valentina Dessi', Matteo Clementi, Alessandro Rogora, Gianni Scudo

Politecnico of Milano – Dept DAStU



maps of average annual energy consumption per capita due to domestic heating and bread production

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

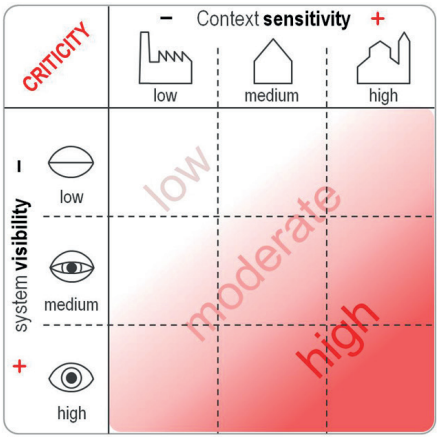
The paper presents the online Simbiopoli tool, which offers the possibility to assess the use of primary non-renewable energy of the residential sector and food consumption through questionnaires filled in by common user. Simbiopoli is a research outcome, developed with the main goal to make people aware of energy consumptions reduction and efficient use of local renewable energy potential. The individual, aware of the impact that his consumption has, can decide whether to change his behaviour and bring environmental improvements. These choices have an impact on social and economic level, as they can help to change behaviour to more people, with a domino effect, and to promote incentive mechanisms by public administrations (increase of local labor force, tax reduction for energy upgrading of homes, or conversion conventional crops in organic farming, etc ...). Such a target is achieved by introducing the common user in simple concepts concerning the territorial metabolism. It has been done through the description of supply chains steps of actual consuming processes and relative impacts. The following step is comparing actual consumes and impacts with those of good practices to point out the environmental benefits of locally based productive systems. The efficacy of the designed practices can be carried out quantifying the reduction of actual environmental impacts through appropriate indicators - square metres of productive land and non renewable energy (nr MJ). Local good practices could disseminate the most interesting experiences in local energy efficiency and food production available. A geo-referenced database represents the core of the tool. It collects the food habits and the heating, cooling, electricity real consumptions data of the dwelling. The information are collected through a friendly questionnaire, while the outcomes are presented in environmental yearly impacts histograms.

KEYWORDS: *URBAN METABOLISM, PRODUCTIVE LAND, PRIMARY NON-RENEWABLE ENERGY.*

SOLAR ENERGY PROMOTION & URBAN CONTEXT PROTECTION : LESO-QSV (QUALITY-SITE-VISIBILITY) METHOD

Maria Cristina Munari Probst, Christian Roecker

EPFL / Laboratoire d'Energie Solaire



architectural criticity of city surfaces

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

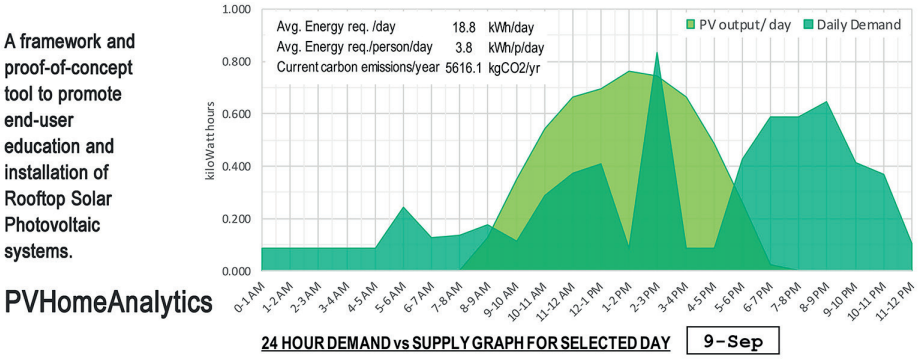
Increased use of solar collectors in buildings is necessary but poses major challenges in existing built environments, especially where architectural coherence is an issue. The large size of solar systems at the building scale requires careful planning, as they may end up compromising the aesthetics of buildings, threatening the identity of entire contexts. A new method named Leso-QSV has been developed to help authorities preserve the quality of pre-existing urban areas while promoting solar energy use. The method is based on the concept of architectural "criticity" of building surfaces. The level of "criticity" of a surface is defined by the Sensitivity of the urban context and by the Visibility of this surface from the public domain: the more sensitive the urban area, the more visible the surface, the higher its "criticity" (Fig.1), and consequently, the need for Quality in integration. The method is composed of two complementary tools, "Leso-QSV Acceptability" and "Leso-QSV Crossmapping". The first is meant for city protection and is addressed to authorities, to support assessing solar systems acceptability: a simple integration quality evaluation method is proposed, and software is provided to help adapt acceptability requirements to city specificities. The second is addressed to planners. It maps the architectural criticity of city surfaces and superimposes it with the GIS solar irradiation map, so as to weight the solar potential of each surface with the expected architectural integration effort. The result shows the interest/difficulty to use the various city surfaces for solar energy production, and helps tailor energy policies to city specificities.
The vision underlining the approach is that solar integration is possible also in delicate contexts, if appropriate design efforts and adequate cost investments are made. [...]

KEYWORDS: *SOLAR INTEGRATION, CRITICITY, SOLAR ENERGY, ARCHITECTURAL QUALITY, URBAN CONTEXT PROTECTION, SOLAR MAP.*

A TOOL FOR THE ASSESSMENT OF ROOFTOP SOLAR PHOTOVOLTAIC POTENTIAL TOWARDS MEETING DOMESTIC ENERGY DEMANDS, USING NEW DELHI, INDIA AS A PILOT STUDY

Mitakshi Sirsi, Anna Mavrogianni, Emily Nix
University College London

Payel Das
University of Oxford



Household demand vs. photovoltaic array supply balance examples

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

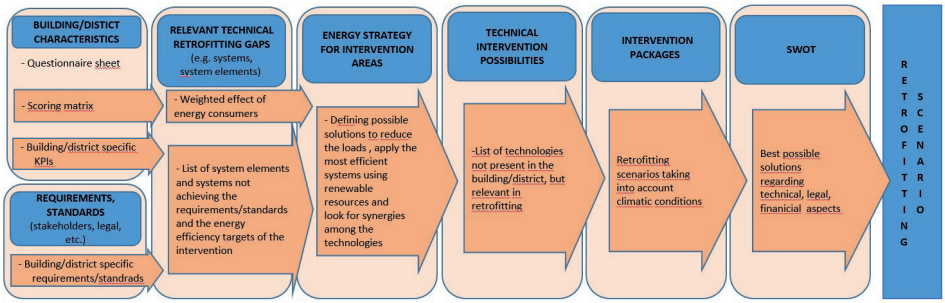
Research Summary

Growing populations, energy access, and economic development are driving higher energy demands in developing countries, and installation of supply alternatives such as rooftop solar photovoltaic (RSPV) systems require relatively low structural and infrastructural changes in cities. However, the lack of availability of robust user-based decision-making tools delay RSPV uptake despite the proven success of the technologies. This paper describes a methodology to calculate household electricity demand and PV-supply balance for current and future scenarios, and its application to a proof-of-concept user-based tool, named PVHomeAnalytics. The tool demonstrates the development of a framework to assess and illustrate the potential, and promote the use of RSPVs in urban centres of developing countries, using New Delhi, India, as a pilot study. Data is consolidated and soft-linked within MS Excel (2013) to create the interactive tool. It includes (i) End-user inputs on energy use, (ii) electricity yield from rooftop solar panels, and (iii) dynamic thermal modelling of selected housing typologies. The tool predicts energy use profiles, carbon emissions, costs, and demand-supply balance of a given household for chosen future scenarios. Initial simulations reveal that 40%-80% of annual electricity demand of a typical (85m2) flat can be met though a 20m2 installation of RSPVs. Predicted demand patterns based on future climate scenarios suggest dependency on thermal comfort appliances in summer (such as air conditioners), increase in appliance ownership, increase in energy intensity and possible decrease in PV yield. The tool is designed to be user-friendly, flexible, and scalable and the framework is applicable to other locations in similar climatic regions. [...]

KEYWORDS: *ROOFTOP SOLAR PHOTOVOLTAICS, ENERGY DEMAND, ASSESSMENT TOOL, DOMESTIC ELECTRICITY DEMAND*

A SYSTEMIC PUBLIC BUILDING AND DISTRICT RETROFITTING METHODOLOGY

Zsuzsa Szalay - ABUD Ltd./ BME, Budapest, Hungary
Ida Kiss, Réka Tóth, Adrienn Gelesz, András Reith - ABUD Ltd., Budapest, Hungary
Amaia Arrien Uriarte - TECNALIA, Spain



Main steps of the methodology

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

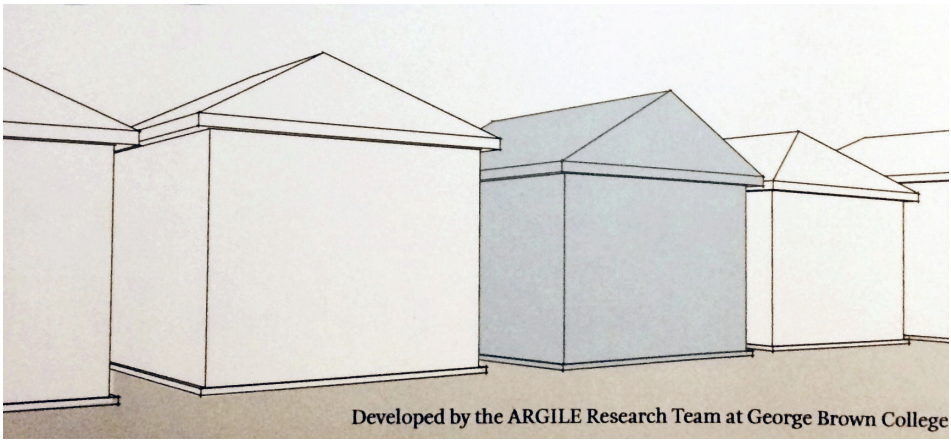
The specific energy consumption of non-residential buildings, of which more than 30% are public buildings, is 50% higher than of residential buildings. The European funded A2PBEER project, therefore, aims at demonstrating the affordable and energy efficient retrofit of public buildings on three real projects covering main climatic areas of Europe. The project will develop a systemic retrofitting methodology and three new configurable retrofitting kits fitted to the Public building/district characteristics in order to achieve Net Zero Energy Buildings. This paper presents the systemic retrofitting methodology developed for public buildings and districts. The step-by-step methodology starts with the analysis of the target building/district to characterise the current conditions through Key Performance Indicators or simplified scoring matrices, which will help identifying the relevant technical retrofitting gaps. Based on general energy strategies, the technical intervention possibilities feasible for the retrofit are determined. Technical intervention packages are selected considering the main objectives of the retrofit as defined by the stakeholder needs and the legal requirements. Finally, these packages will be evaluated from financial, technical and legal aspects through a SWOT analysis to assist decision making. Based on the methodology a user-friendly online tool is developed that assists building owners and managers in the early stages of the design to select the most favourable sustainable retrofit solution. Such methodologies and tools already exist for residential buildings, but not for public buildings and public districts.

KEYWORDS: *PUBLIC BUILDING, RETROFITTING, SYSTEMIC, METHODOLOGY*

HOME RETROFIT GUIDE FOR EXISTING BUILDINGS IN A COLD CLIMATE

Steffanie Adams

George Brown College



Cover for the Home Retrofit Guide

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

With the rising cost of energy and older homes comprising the majority of most cities' housing stock, a large strain is being placed both on the consumers' wallet and the environment. While new construction can be built with these issues in mind, the demolition and construction of new homes has equally devastating effects. Our proposed solution is to effectively revitalize the existing housing stock. This research explores innovative combinations of materials and methods to develop cost-effective, sustainable, durable and healthy renovation and retrofit techniques. Our goal is to provide homeowners with a transparent and easily accessible guide to retrofits, help builders assess and respond to otherwise challenging older homes, inform companies which building products perform best, and to encourage our cities to act as leaders in urban sustainability. Greater transparency and understanding of the options available will help encourage more users to explore retrofitting options with their existing building, helping to reduce energy consumption, lower energy costs, and mitigate some of the environmental damage associated with demolition and new construction. This guide answers the questions "What are the best technologies (materials and methods) for achieving energy efficiency within the constraints associated with vintage buildings?" and "What is the cost/benefit of retrofitting vintage building?"

KEYWORDS: *Retrofit, Revitilization, Sustainability, Efficiency, Constructability, Durability, Occupant Health and Comfort*

25 YEARS OF SHAPING FUTURE ARCHITECTS AND ARCHITECTURE - THE EVOLUTION OF A SUSTAINABLE BUILDING CURRICULUM

Liane Thuvander, Paula Femenías, Barbara Rubino, Michael Edén

Chalmers University of Technology/Department of Architecture

Students on the Masters level design and construct an apartment for students for the international student competition "Solar Decathlon 2013", held in Datong China, 3rd place. www.halosweden.com

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In order to approach an architecture beyond green, the architect's role and knowledge base has been challenged during the last decades. How far have we come with the education of future generations of architects? The aim is to discuss the shifting paradigm for architectural education towards an integration of sustainability aspects. By looking back 25 years, we examine the development of the sustainable building curriculum at the Department of Architecture, Chalmers, Sweden. The story is told by staff, i.e. teachers and researchers involved to a varying degree in the development of the curriculum. Document studies and information searches has been carried out together with a focus group meeting. Based on four courses the discussion revolves around the extent of the curriculum, learning progressions, and collaboration with other disciplines and outside academia. The sustainable curriculum on the Masters' level is highly attractive for international students. Participation in the international student competition Solar Decathlon shaped a new generation of attractive architects. In order to keep up with knowledge development, integration of different disciplines and stakeholder groups from the construction sector is necessary as well as further education of the teachers. Improved cooperation with other universities, nationally and internationally, could support a better integration of the sustainability curriculum. Finally, evolution is a long-term process, it takes time to shape architects and our future built environment in a sustainable way. Important factors for success are integration, collaboration, continuity, progression, and enthusiasm!

KEYWORDS: *ARCHITECTURAL EDUCATION, SUSTAINABLE CURRICULUM, LONGITUDINAL STUDY*

LIANE - LABORATORY FOR AN INTEGRATED AFRICAN NETWORK FOR THE BUILT ENVIRONMENT

Astrid Weisel, Susanne Gampfer
University Applied Science Augsburg

Michelle Stadelman
University of Rwanda

Periurban area near Nairobi/ Kenya

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

LIANE is an applied research project with the target to improve the quality and sustainability of settlement planning in agglomeration areas of secondary cities and other urban growth corridors in the region of the Great Lakes in East Africa, in an effort to mitigate the settlement pressures on the capital cities. As it is a cooperation project of different universities from Germany, Kenya, Rwanda and South Africa, the aim, on the one hand, is to develop new building and urban typologies based on the local context, the existing climatic conditions, the available resources, and the identity of the area and its inhabitants. On the other hand, the aim is to provide sustainable analysis and planning methods for communication and training within the team/network, especially relevant for planners in the specific countries. Through the involvement of local planning authorities, practitioners, and other stakeholders, a better connection between academic research and practical applications is achieved. In addition to the development of concrete planning interventions for selected neighbourhoods within the analysed corridors, more general tools and guidelines for similar planning situations are derived particularly in regard of the challenges like urban and uncontrolled population growth, access to energy, water, and improved sanitation facilities; also for lower income groups, housing affordability, as well as roads and infrastructure development.

KEYWORDS: *AGGLOMERATION AREA, URBAN SPRAWL, TOOLS AND PLANNING GUIDELINES, TRAINING SKILLS*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

+ Resilience – Vulnerability

1st Parallel Session

DAY 1

14:00 – 16:00

CHAIRMEN

Cristina Garavelli ..... Table 11
Denise Duarte ..... Table 12

ACCESS TO EDUCATION, CLEAN ENERGY AND WATER AS BASIC ELEMENTS OF BUILDING GREEN FUTURE ON THE EXAMPLE OF CHILDREN'S CENTER IN THE GAZA STRIP

Barbara Widera

Wroclaw University of Technology, Faculty of Architecture

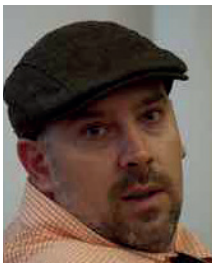
ARCò and MCA, The Children's Land in Um al Nasser, 2012 © ARCò

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper presents bioclimatic architectural solution applied in the children's education center located in Um al Nasser in the Gaza Strip (Palestinian Territory) and called the Children's Land (La Terra dei bambini). The edifice was developed in purpose to create safe, healthy and comfortable educational facility for the children. The authors of the project: ARCò Architettura e Cooperazione in cooperation with MCA Mario Cucinella Architects, were focused on providing local people (especially children and women) with access to water as well as introducing clean energy and renewable resources into the challenged area of the Gaza Strip. These elements were perceived as basic factors contributing to the idea of building green future. Preventing further destruction of the ecosystem was also very important for the project. The earth-bag technique was used in purpose to construct the building in a very short time and to take advantage of locally available, cheap materials. The aim of the paper is to show how this innovative low-cost and low-tech structure promotes the environmental safety in balance with contemporary technology and with respect to the local culture which leads to the establishment of new, sustainable and replicable architectural model. The paper analyzes the relations between indigenous tradition and bioclimatic strategies. Presented approach provides appropriate and feasible solutions to the social, environmental and economic challenges of the Gaza Strip, but can be also followed in other regions.

KEYWORDS: *IMPROVING LIFE QUALITY, BIOCLIMATIC DESIGN, EDUCATIONAL FACILITY, ACCESS TO WATER, CLEAN ENERGY*

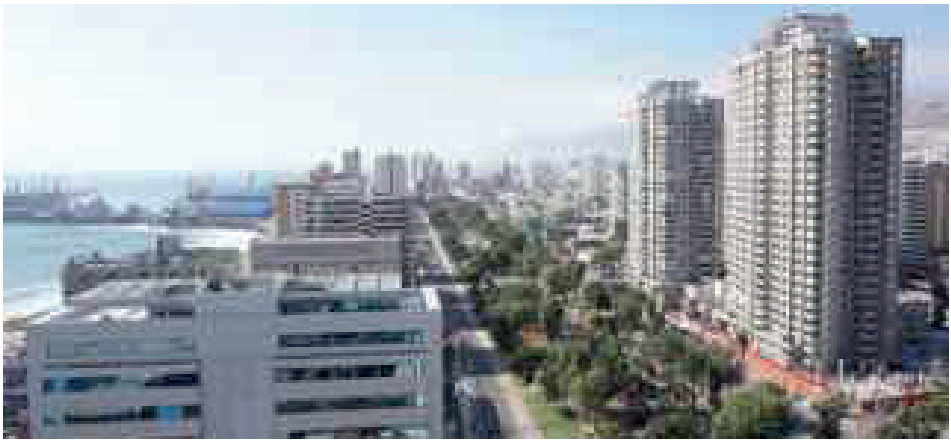


CLIMATE CHANGE AND URBAN FORM: SIMULATION STUDIES IN TEMPERATE CLIMATES

Massimo Palme - Universidad Católica del Norte

Carola Clemente - Università di Roma La Sapienza

Antoni Isalgué Buxeda - Universitat Politècnica de Catalunya



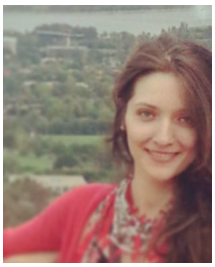
Irregular urban development in Antofagasta, Chile

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Humanity is facing important challenges in the next years. The United Nations set of Sustainable Development Goals (United Nations, 2014), to be adopted in September 2015, underline that climate (goal 13: take urgent action to combat climate change and its impacts) and urban issues (goal 11: make cities and human settlements inclusive, safe, resilient and sustainable) are two of the most important of these challenges. Climate is changing and urban population is growing very fast, leaving many people in exposition to extreme events and making more difficult to build the cities resilience. Climate change adaptation requires the understanding of the urban response to warmer environment and heat weaves. Architectural R(solution) proposed in this paper consist in a parametrical interpretation of simulation studies, searching for more adaptable urban forms, which could respond to future modified climates. Three different temperate locations are tested (Rome, Barcelona and Antofagasta), to obtain results that could be generalized and indicate the importance of design variables like density, buildings' height, urban matrix orientation facing sun and wind, and cities' greening strategies.

KEYWORDS: *Envi-met, Urban Form, City Cooling, Natural Ventilation, Global Warming*



EVALUATION STUDY OF A NUMERICAL MODELLING SYSTEM

Elmira Jamei, Priyadarsini Rajagopalan, Parisa Izadpanahi

Deakin University

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

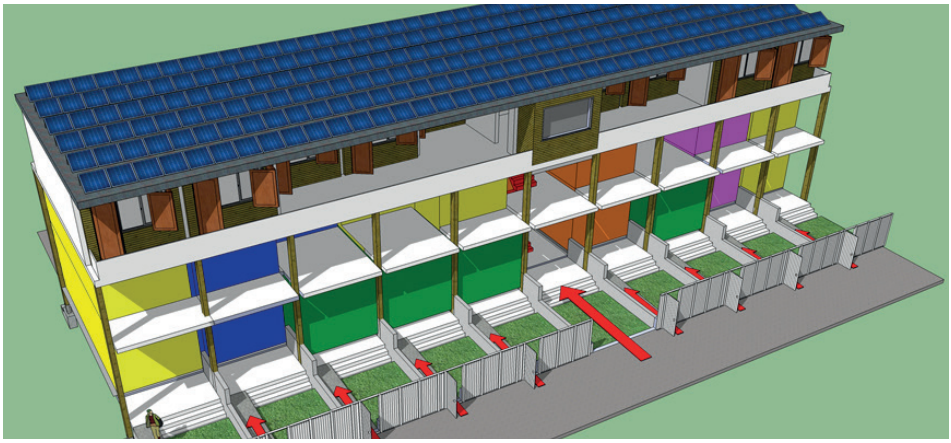
Research Summary

Numerical modelling has been widely used in urban studies, but the reliability of such models has been always a great concern among scholars. This paper is an investigation on ENVI-met, one of the most well-known modelling systems, to discern its ability in simulating the spatial and temporal variability of microclimatic parameters. This study first reviews the previous researches that validated ENVI-met and reports the causes of the discrepancy between the measured and simulated outputs. This paper also conducts a validation study on the variation of the air temperature and relative humidity, in one of the rapidly growing urban areas in Melbourne, Australia. In order to validate ENVI-met, field measurements were conducted in 6 th January 2015, a typical summer day, via HOBO data loggers and a portable weather station at seven different points in the study area. The simulations were run for the same day, to examine whether there is a deviation in the results of the simulation against the field data. The outcomes of this study will help urban planners to confidently apply ENVI-met in evaluating the potential adverse impacts of urbanization on microclimate of the cities.

KEYWORDS: *ENVI-met, Field measurement, Simulation, Urban planning*

SUSTAINABLE REHABILITATION AND DENSIFICATION OF A PUBLIC HOUSING NEIGHBOURHOOD IN MILAN

Gian Luca Brunetti — *Politecnico di Milano*
Paolo Carli — *Politecnico di Milano*
Anna Delera — *Politecnico di Milano*



A perspective scheme of the defined project.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In 2012 our research team was tasked by the Agency for Public Housing of the Lombardy Region with carrying out a participated feasibility inquiry for the renovation and extension of a publicly owned social housing complex in Milan, constituted by six linear blocks, each one organized in 10 duplex apartments with private gardens facing south. The complex still featured the qualities for the attainment of a good quality of life, but was stricken by insufficient maintenance and scarce possibilities of improvement due to technical difficulties of upgrading to code compliance. In 2008, the complex was singled out for complete demolition and destined to building new mixed-ownership (private and public) residential units implying a doubling of the number of apartments and a new rent/ownership ratio. That plan may have been seemed in some sense justified by the actual pattern of land use: the complex was indeed underused and might have been considered inadequate for the creation of new apartments. But in the opinion of the authors a complete demolition was not the most viable option. The latter view was also shared by the inhabitants, that with their firm resistance succeeded in stopping the demolition and redevelopment process and obtained the commissioning of the here presented feasibility inquiry, with the purpose of soliciting the definition of new renovation and expansion strategies carried out with criteria of social and environmental sustainability. The strategies defined for that task took a stance with respect to major themes of the contemporary debate, like: the integration of "parasite" architectures as opportunities to increase the space available to apartments; densification as a strategy against land consumption; energy saving and environmental impact reduction as core design objectives; the definition of new housing typologies allowing for flexibility and adaptability to evolution processes; [...]

KEYWORDS: *PUBLIC HOUSING, BUILDING REHABILITATION, NEIGHBOURHOOD REHABILITATION, HOUSING RETROFIT.*

MICROSCALE ANTHROPOGENIC HEAT IN A TROPICAL HIGH DENSITY CITY

Daniel Jun Chung Hll, Nyuk Hien Wong, Steve Kardinal Jusuf

National University of Singapore

Vehicles as anthropogenic heat source in the deep canyon of Robinson Road in the CBD.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

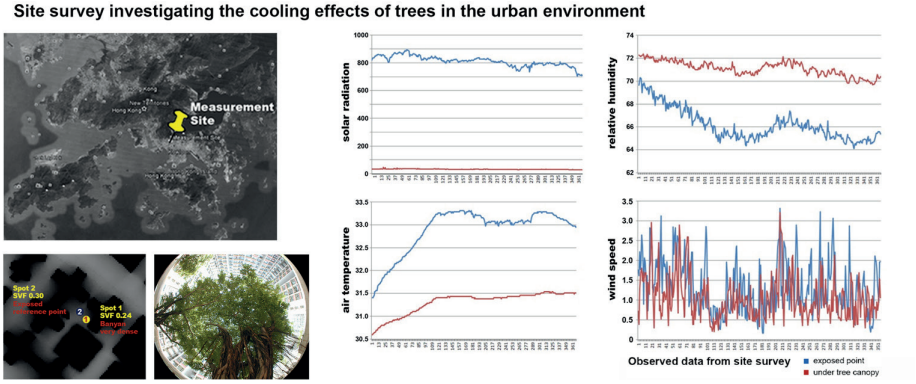
Research Summary

Human beings are anthropogenic heat sources which contribute to the thermal and air pollution in the city via the buildings, vehicles and human metabolism. As cities get denser and with increased population, anthropogenic heat accumulation becomes a significant issue that affects energy consumption and thermal comfort. Understanding its magnitude of impact to the dense urban environment helps us plan better. The research seeks to investigate the contribution of anthropogenic heat at the pedestrian level to air temperature, where most people are located outdoors. From the weather stations mounted at the Central Business District (CBD) to the roadside measurements, it was found that anthropogenic heat does affect the rise of dry bulb / air temperature. CO2 and NO2 concentrations at pedestrian level have good correlations with air temperature. The contribution of vehicles heat can be simulated in the Computational Fluid Dynamics (CFD) software to understand its impact on heat dispersion with various urban forms so decisions can be made in the future to use suitable geometric variables and urban forms that respond better to heat (and pollutant) dispersion.

KEYWORDS: *TROPICAL, HIGH RISE, HIGH DENSITY, ANTHROPOGENIC HEAT, PEDESTRIAN HEIGHT, SITE MEASUREMENT*

DESIGN FOR CLIMATE RESILIENCE: MORPHOLOGY-BASED PLANNING OF ROADSIDE TREE PLANTING IN SUBTROPICAL HIGH-DENSITY CITIES

Zheng Tan - School of Architecture, The Chinese University of Hong Kong
Edward Ng - School of Architecture, The Chinese University of Hong Kong Institute of Environment, Energy and Sustainability, The Chinese University of Hong Kong, Institute of Future Cities, The Chinese University of Hong Kong



On-site measurement investigating the environmental effects of trees in urban areas

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

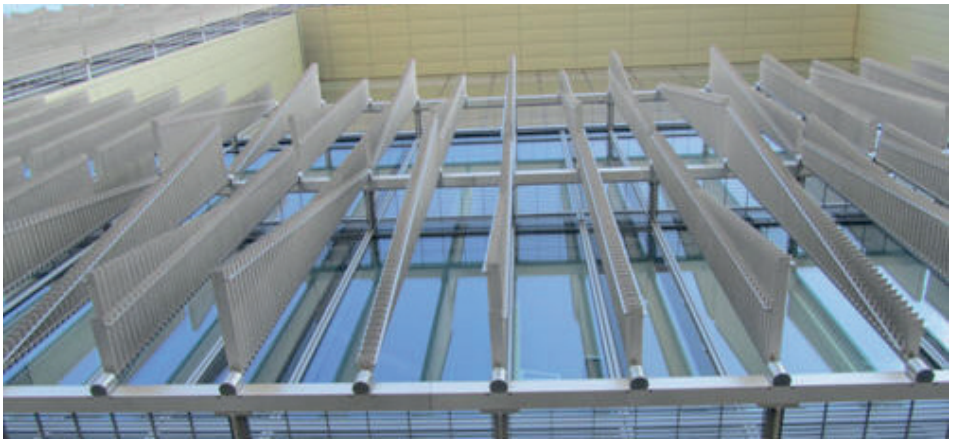
Growing urbanisation in the subtropics increases the vulnerability to climate change of the regions. Urban climate in hot-humid subtropical areas has been less studied. Research on thermal effects of roadside tree planted under critical hot sunny weather and typical summer cloudy weather, both are predicted to be more dominant as the result of climate change, can provide essential information for building climate resilience in high-density subtropical cities with greenery design. The study investigates the microclimate regulation of roadside trees in built environment with measurement and simulation. Observed data indicate that the cooling outcome of trees is related to SVF and the influence of building geometry is more evident in cloudy condition than sunny condition, which emphasizes morphology-based planning strategies for greenery design. Simulation results show that roadside trees reduce the air temperature by 1 degree and surface temperature by 14 degree in high-SVF areas in sunny condition. Cooling magnitude presents larger spatial diversity in areas with lower SVF. The study demonstrates that roadside trees reduce the mean radiant temperature to 34 degree under SVF of 0.2 in cloudy days, which indicates that as a passive way to cool the city, tree planting in subtropical cities can provide a comfortable radiant environment in heavily built areas for over 50% of the summer period.

KEYWORDS: *SUBTROPICAL CITY, HIGH-DENSITY, CLIMATE RESILIENCE, URBAN GREENERY*

TOTAL BUILDING AUTOMATION FOR THE NEARLY-NET-ZERO-FOSSIL-ENERGY Q1 THYSSENKRUPP HEADQUARTER

Thomas Spiegelhalter

Florida International University



Q1 ThyssenKrupp Quarter with automated solar and daylight control system, JSWD Architekten and Chaix & Morel et Associés, 2006. (Image: Thomas Spiegelhalter, 2013.)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper investigates the schematic and automated workflow for the integrated project delivery of the Q1 ThyssenKrupp Quarter in Germany. This includes the early design stage, 3-D-simulations, detailing, file-to-production process, assembly, commissioning, benchmarking, and the total green building automation. The example critically evaluates how the German Thyssen-Krupp headquarter's real-time SIEMENS total green building automation system (BAS) performs with intelligent control feedback loops and learning algorithms for constantly optimized building performance, security, and user comfort operation.

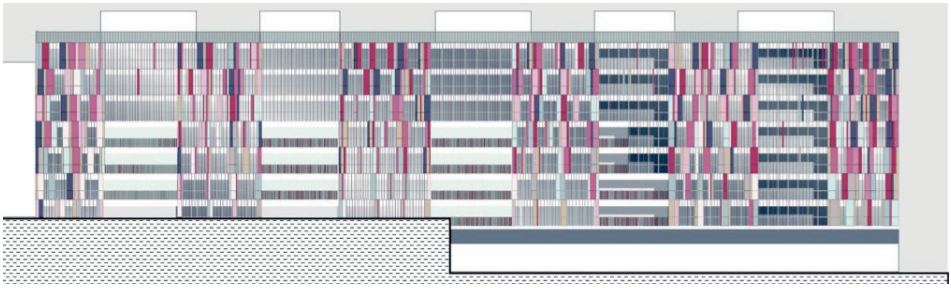
The BAS also includes a wireless environmental management system to ensure trend analysis and optimizations toward yearly net-zero-energy certifications based on the mandatory yearly European Building Energy Performance Certification system. The paper concludes that there is no doubt that green automated design and virtual-to-real manufacturing will reorder the global AEC business for decades. The AEC industry that capitalize on these changes across their entire development will set the tone that others will be challenged to follow to remain competitive.

KEYWORDS: *Sustainability, Net-Zero-Energy, Carbon Neutral, Total Building Automation, Human-Computer-Intercae, Digital Mock-Up*

BUILDING RETROFITTING TAILORED SOLUTION WITH BIM TECHNOLOGY: A CASE STUDY ON SOCIAL HOUSING FROM THE 1980'S IN ROME, ITALY

Alberto Raimondi, Marika Prete

Uniroma3



Proposal for the new facade.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Retrofit, not demolish. The larger part of the residential buildings constructed in Italy between the 1950s and the 1980s is made up of buildings that consume large amounts of energy and offer little comfort levels in return. Tearing down and rebuilding is an option that is not only taxing on the environment but also requires a long-term living alternative for the tenants. Retrofitting on the other hand has less environmental impact and limits the tenants' inconvenience.

Digital analysis and design tools allow us to foresee surrounding conditions and the effectiveness of the shell. However, modelling and analysing multiplied by hundreds of housing units has a design cost that is seldom sustainable. The challenge is that of creating a tailored design for large numbers: different conditions found in each unit should lead to a case-specific design therefore increasing cost. Is it possible to imagine a careful and varied design for 140 projects, without its cost? The focus of the research is on specific objectives such as improvement of energy saving performance, thermal and visual comfort for each unit and a renewed image for the building. The analysis carried led to an Irradiance mapping through Autodesk Vasari leads to the choice of sample units. These are then further analysed and mapped for thermal dispersion using EnergyPus+OpenStudio software and the Lighting Analysis add-in for Autodesk Revit for daylighting. The results show positive and negative extremes within the facade. The results are then used to create an envelope system of architectural parametric components, with different performance levels regarding glazing area and insulation. These components can vary their dimensions and thermal properties and can be combined to create the facade. The "re-composition" phase is based on finding a compositional rule within the facade patchwork through the information given by the Irradiation maps.

KEYWORDS: *RETROFITTING OF SOCIAL HOUSING, TAILORED FACADE, BIM, THERMAL COMFORT, VISUAL COMFORT*

THE INTERLOCK HOUSE: COMMUNICATING SUSTAINABLE PRACTICES THROUGH ARCHITECTURE

Kelsey Fleenor - Iowa State University, Center for Building Energy Research

Ulrike Passe, Shan He - Iowa State University, CBER

Interlock House at Honey Creek Resort with Basement Addition

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

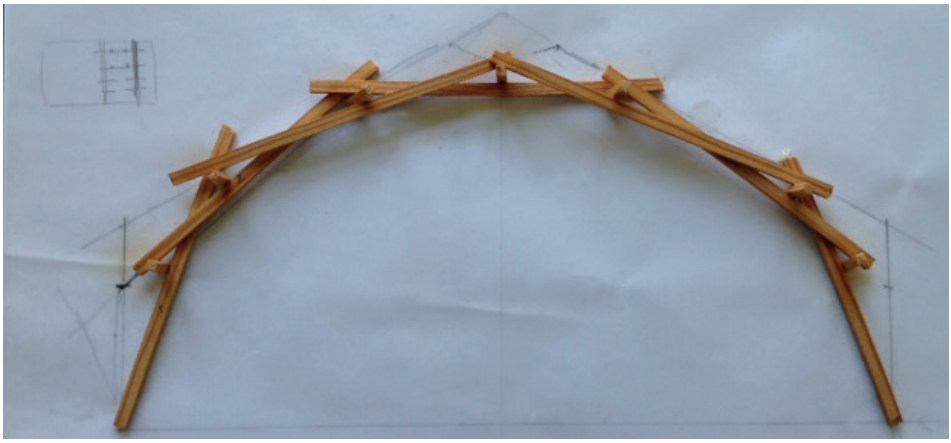
While architecture influences human behavior, human behavior also affects architecture. Buildings mitigate the outdoor elements to keep occupants safe and warm while also pleasing us by making a space comfortable and enjoyable. However, both the efficiency and experience of a building change as occupants interact with the space, such as opening windows and closing blinds. Contemporary society has grown accustomed to mechanical systems doing all the work to maintain a comfortable environment, which often removes the interaction of the occupant with their building completely. The Interlock House, one of the entries for the Solar Decathlon held by the U.S. Department of Energy (DOE) in 2009, was designed to integrate both innovative technology and passive operational strategies to maximize the energy efficiency of the home while allowing flexibility to maximize personal comfort. The purpose of the research outlined in this paper analyzes the efficiency of the Interlock House as a case study on educating the public on sustainable design and practices that are both feasible and economical.

KEYWORDS: *Architecture, Communication, Post Occupancy, Sustainable Design, Sustainable Practices*

SUSTAINABLE HIGH PERFORMANCE BUILDING STRUCTURES USING LOW-QUALITY LOCAL DANISH TIMBER

Olga Larsen, Daniel Lee
KADK

Torben Lange
Aticon



An Reciprocal Frame arch structure – starting point for the farm building

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

"The construction industry consumes more than one third of global resources, including 12 % of all freshwater use. Also, buildings use 25–40 % of the total energy produced, accounting for approximately 40 % of global carbon dioxide (CO2) emissions. In addition to natural resource consumption, buildings produce and unload 30–40 % of solid waste into the environment" (Taipale, K, 2012)
Furthermore, our world is quickly becoming more urban than rural: by 2030, an additional 1.4 billion people will live in cities, mostly in the developing countries. In the coming decades, we will experience
more construction than ever before, to provide homes in the cities. Having in mind the negative effects of construction, there is an urgent need to address the long-term impacts of the volume and speed of increase in the building sector. In order to deal with the two issues, we must:
1. Create alternatives to living in cities, i.e. establish a clean, sustainable and non-polluting rural economy that would attract people to stay in the countryside, by which the growth of cities could be slowed down;
2. Build in a holistic, sustainable way using local, renewable, reusable construction materials, utilising green energy.
This paper presents a case study of an applied research project that does all the above: it creates a successful rural business giving an alternative to living in the city. The meat production, described further in the paper, is of high quality and organic, successfully competing with intensive meat production typical for Denmark. The project is holistic-sustainable on all levels: with known and untested renewable energy sources, use of waste products, local materials and design for reuse.

KEYWORDS: *ORGANIC MEAT PRODUCTION, SUSTAINABLE BUILDING, HIGH-PERFORMANCE TIMBER STRUCTURES, LOW-GRADE LOCAL TIMBER, RENEWABLE ENERGY SOURCES*

LIGHT AND THERMO-ENERGETIC EFFICIENCY OF ZENITHAL LIGHTING DEVICES IN EXPOSITIVE SPACES AT THE WOOL FACTORY TURNED INTO "THE HOUSE OF MUSEUMS"

Lívia Bender, Celina Correa

Univerdidade Federal de Pelotas

Carlos Ritter Museum

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

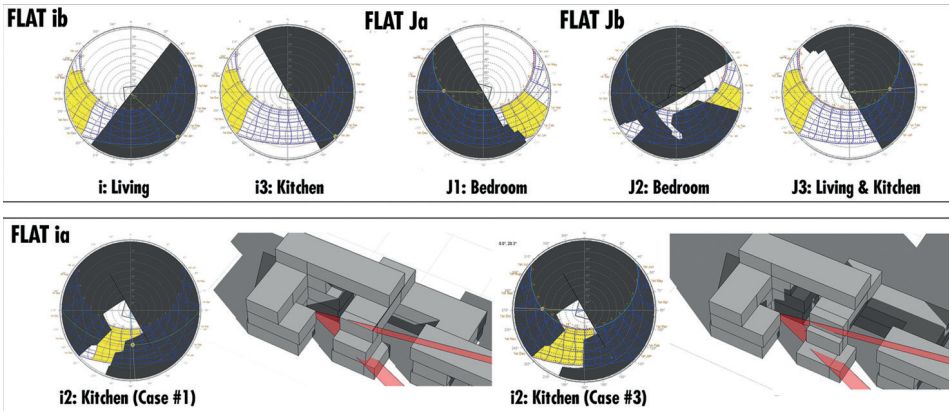
The correct use of natural lighting in museums and exposition spaces is a structural factor of these environments, because of the daily and seasonal variations this type of lighting presents. The current study analyzed the lighting and temperature conditions of both expositive spaces at "Laneira Brasileira" (Brazilian Wool Factory), building undergoing a recycling process to host "The House of Museums" from the Federal University of Pelotas. The building is located 30° South latitude, in the city of Pelotas, Brazil's Deep South. We aimed to obtain the best results regarding lighting and thermo-energetic performance of zenithal lighting devices designed for these spaces, so we could orient in an adequate way the decisions regarding the project. The method employed for this study was the analysis of lighting and temperature data collected from models in reduced scale, through sensors strategically placed inside them.

KEYWORDS: *NATURAL LIGHTING. MUSEUMS. ENERGY EFFICIENCY. MODEL.*

SOLAR ACCESS IN HIGH DENSITY URBAN DEVELOPMENTS: A REPRESENTATIVE CASE IN MATLOCK

Heba Nazer
Middle East University

Lucelia Rodrigues
University of Nottingham



Stereographic projection of annual solar access to ground floor unit in the Matlock residential blocks

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Solar access is the ability of a property to receive sunlight without obstructions. It is essential in well-designed urban districts and even guaranteed by law in certain countries. The provision of solar access to dwellings in the UK contribute to the reduction of energy consumption used for space heating in desired periods of the year, in addition to contributing to individuals' psychological well-being. However, solar access can be very difficult to achieve in dense urban developments because other buildings may block the desired sun from adjacent masses as a result of poor layout planning. Nevertheless, high density is in many places an intrinsic part of sustainable living, and hence, a necessary target to meet.

In this study, the authors investigated the implications of the solar envelope zoning approach in the design of residential blocks in a town centre development in Matlock, UK. This design method influenced the form generation process and ensured solar access in each apartment with the required sunlight penetration during the hours of occupancy. Several iterations have informed the optimization of the form and the removal of parts of the design that were obstructing the adjacent buildings' solar access. Ecotect software by Autodesk was used to model the sunrays penetration in the desired zones at specified times. The development combined 30 apartments targeting different age groups, with roof terraces and courtyards distributed on three levels with great consistency. This resulted with an extraordinary variety of vistas and enclosures with optimum penetration of daylight and ventilation for each different occupancy and dwelling type. Hence this design represents an exciting example of urban planning that employs the concept of solar envelope with creativity in design to link the community socially, environmentally, and visually with the context.

KEYWORDS: *Solar Envelope, Solar Access, Sustainable Urban Planning, Daylight design*

URBAN WATER REVOLUTION THROUGH SUSTAINABLE TECHNIQUES: STUDY OF AURANGABAD CITY, INDIA

Prof. Shekhar Nagargoje, Prof. Avadhoot Dixit

NICMAR Pune

Grey Water Intervention at Urban Scale

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

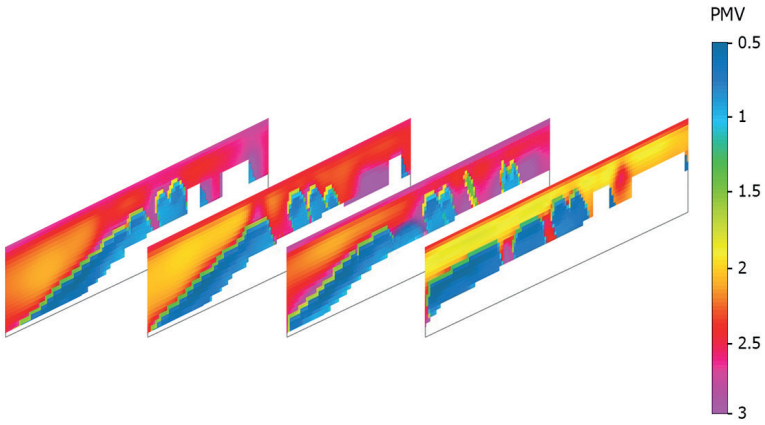
Currently the domestic water supply in the city of Aurangabad is at the rate of 24 LPCD in rural areas and 72 LPCD in Urban areas, way below the standards. With growing population and rapid urbanisation the city of Aurangabad might face the water crisis in the coming future. Hence a sustainable approach of water management is adopted in this study to develop city's resilience towards water scarcity. A study of existing water supply and demand of Aurangabad is conducted based on primary and secondary sources to understand the extent of water supply deficit and the potential sustainable solutions. Efforts were made to study urban water management techniques and best practices used in other parts of the world. Use of Grey water management principles by developing various typologies for different Urban forms and its integration at urban level can help address the problem of water situation at Aurangabad. It was found in this study that if grey water solutions are provided at various levels it has a reuse potential up to 33% this water can cater the need of water supply for various purposes, thereby reducing the deficit and gap between haves and have not's.

KEYWORDS: *Urban Water, Grey Water Management, Sustainability, Urban Resilience*

EXTREME CLIMATE EVENTS: THE TOMOGRAPHIC ENVIRONMENTAL SECTION FOR ENVIRONMENTAL MITIGATION DEVICES

Enrico Prenna, Roberta Cocci Grifoni, Maria Federica Ottone, Anna Bonvini

University of Camerino



Tomographic sections of an urban heat wave

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The Fifth Assessment Report (AR5), the last release by the IPCC, and the "State of the Climate: Global Analysis for December 2014", published by the NOAA, confirm the growing trend for the annual global temperature and make clear that only the reduction of carbon emissions can be the basis for a meaningful policy to counteract climate change. These considerations explain the importance of urban - architectural resilience and the need to reduce energy consumption to restrain the global warming. Therefore the design of urban spaces can be considered "thermodynamic mediation" between the constructed object, the human body, and space (environment), between meteorology and physiology (meteorological architecture). One of the key aspects of this approach is design based on meteorological conditions, weather, climate forcing, and thermodynamic demands to obtain architectural and urban shapes that is not only longer conceived in a "structural" sense, but rather "climatologically oriented". Investigating the environment through tomographic sections processed with CFD software (Tomographic Environmental Section, TENS), it is possible to evaluate the effects of an extreme event on an indoor/outdoor space in order to design appropriate (adaptive) climate mitigation devices, focusing on needs of countries with uncomfortable climate and limited resources. By "slicing" the environment and studying the initial and border conditions, building and environmental performance simulations for outdoor spaces are analyzed in order to test extreme events (heat waves) using climate data series.

KEYWORDS: *GLOBAL WARMING, METEOROLOGICAL ARCHITECTURE, COMFORT OUTDOOR, TENS METHOD, CFD*

ECO HOUSING: PROTOTYPICAL EXAMPLES FOR RURAL BANGLADESH

Mujtaba Ahsan, Shahriar Iqbal Raj
North South University

Nafizur Rahman
Housing and Building Research Institute

Traditional construction worker building prototype house roof

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Almost 81% of the housing stock in Bangladesh is in the rural areas of which 69% are of indigenous construction. Because of its geographical position the country is vulnerable to periodic flood, cyclone and other natural disasters including riverbank erosion. The traditional households built with indigenous and organic material are largely vulnerable to natural disasters and natural agents of decay. Resilient housing stock for the large rural population is a precondition to the growth and improvement of the socio-economic conditions of the people. With the greater introduction of television, radio, electric lighting and mobile telephone in the rural areas, the demand for electricity is rising in the backdrop of inadequate supply. The Housing and Building Research Institute (HBRI) developed six dwelling prototypes to meet these challenges to be replicated in the rural settings. Of the six units developed, four are discussed in this paper. To reduce structural vulnerability brick lined plinth with stabilized sand fill was proposed to prevent damage due to flood and moisture. Structurally reinforced superstructure integrated with a stabilized plinth was proposed to provide resilience against cyclone. Covering of bamboo mat wall with plaster was developed to improve the durability of the walls significantly. Each unit was connected with solar panel, battery and inverter to provide alternative energy and shared a community bio gas plant to meet cooking energy need. Sanitary toilet and separate kitchen were provided to ensure hygiene, along with rooftop rainwater harvesting to supplement potable water supply, keeping in mind, particularly areas where arsenic in ground water is a severe health issue.

KEYWORDS: *ECO-HOUSING, SHELTER, HOUSING, ALTERNATIVE ENERGY, SETTLEMENT*

DESIGN, OPTIMISATION AND CONSTRUCTION OF A STEEL FRAME EFFICIENT HOUSE IN A SOUTH EUROPEAN COUNTRY

Fernanda Rodrigues, Rui Oliveira, Romeu Vicente, Ana Alves - University of Aveiro

Laertes Mota - MODIKO

Modiko Passive House

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper is based on the industrial research venture project "MODIKO Passive House" consisting on the development of constructive solutions, optimisation and redefinition of a Steel Frame constructive system in order to comply with the requirements of the Passive House standard. After design optimisation the modular house was built in Aveiro, located on the central coast of Portugal. The Passive House concept aim to promote high-energy efficient buildings' construction, as they are essential to fulfil the future goals established by the Energy Performance of Buildings Directive (2010/31/EU, EPBD).

A detached two-storey prefabricated lightweight steel structure with contemporary architecture was modelled for Portuguese climate, based on its original design solutions (according to Portuguese regulations) and using the PHPP 8 (Passive House Planning Package) software.

Comparing with the original solution, the improved results for the climate region of Aveiro, in Portugal, have led to a reduction of 69 %, 84 % and 20 % for the heating and cooling demands and for the overheating rate, respectively. The results achieved comply with the Passive House requirements including a high thermal indoor comfort with low consumption and low carbon emissions.

After optimising the project using the PHPP8 the modular house was built in Aveiro and will be monitored to validate the thermal balance results.

The high energy efficiency obtained by the application of the Passive House concept allows the reduction of fossil fuels dependence and consequently huge economic savings during the building life cycle.

KEYWORDS: *Passive House, Energy, Efficiency, Thermal Comfort*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

+ Resilience – Vulnerability

2nd Parallel Session

DAY 2

10:30 – 12:30

CHAIRMEN

Rajan Rawal ..... Table 11
Giulia Pentella ..... Table 12

IMPROVING THE RESILIENCE OF ITALIAN CITIES THROUGH URBAN WATER METABOLISM

Federica Paolini, Carlo Cecere

University of Rome

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In recent times, accelerating urbanization, increasing scarcity of resources and waste production require a redesign of urban systems towards a more sustainable management. Global changes force urban systems to find solutions that minimize the demand of resources and to shift from linear to circular metabolism, in which recycling and reusing are key activities. The most critical urban flow is water, followed by energy and material flows: water is vital for our survival, it is not renewable or replaceable and it represents the largest component in terms of sheer mass of the urban metabolism of a city (Kennedy, Cuddihy & Engel-Yan, 2007). Urban metabolism and Material Flow Analysis are widely acknowledged tools to monitor and assess resource use, in order to comprehend cities' environmental impact and propose adequate sustainable development policies. However, due to the complexity of contemporary urban phenomena, it is difficult to understand what happens within those urban systems and to answer to these current pressures. Urban metabolism studies consider the city as a "black box", quantifying in-flows and out-flows. Indeed, resources availability depends strongly on local context characteristics that enable the reduction of input water flows, maximizing the reuse of wastewaters and closing water loops. Along with the new challenges of sustainable design, it is possible to define different scenarios and roadmaps for compact cities, following the principles of urban metabolism and developing decision support systems. The project aims to measure the degree of sustainability of a Roman city district, mentioning the potential improvements in terms of closing water cycles and outlining strategies to boost territories' competitiveness. The innovative approach enables sustainable actions at the neighborhood level, through the identification and assessment of a set of green projects to suggest pathways that enhance the modification of water metabolic flows.

KEYWORDS: *URBAN WATER METABOLISM, RESOURCE MANAGEMENT, SUSTAINABLE DEVELOPMENT, COMPACT CITIES, WATER CYCLE, RESILIENCE, CIRCULAR ECONOMY*

A NEW STRATEGY FOR WATER CONSERVATION WITHIN THE BUILDING IN HOT ARID REGION: EGYPT AS A CASE STUDY

Usama Elfiky

Kafr Elshiekh University

Sloan-o-matic Low Flow Showerhead

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Less than one-fifth of one percent of our planet's water is accessible fresh water, and only about 30 percent of that is potable. Over 80 percent of municipally supplied water is used in buildings.

Inefficient use of water is the most crucial environmental and development problem in Egypt. Population and GDP growth and urbanization are rapidly increasing water demand. In Egypt, water is scarce but not treated as an economic good. People therefore have little incentive either to conserve water or safeguard its quality, thus leading to overuse and degradation.

Per capita fresh water availability in Egypt dropped from 1893 cubic meters in 1959 to 900-950 cubic meters in 2000 and tends to decline further to the values of 670 cubic meter by 2017 and 536 by 2025. [Abd-El-Hai, 2002]

This paper is discussing available techniques for water conservation and searching for new. This will be managed through a questionnaire process of householders in Egypt. The paper goal is to figure out the level of community acceptance for each technique and which is effective for water conservation as a concept of green architecture.

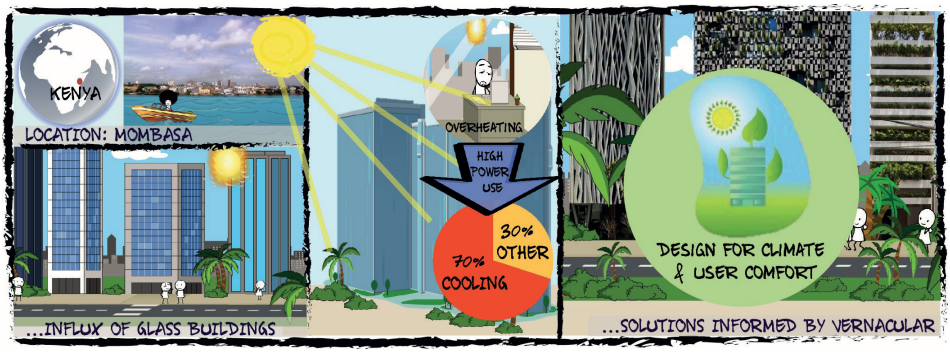
The results end with a holistic strategy for water conservation within buildings in Egypt. The study is an initiative for a new rating for water conservation techniques as a green architecture strategy.

KEYWORDS: *Rating system, green architecture, water conservation, culture*

THE APPLICATION OF VERNACULAR SWAHILI ARCHITECTURE STRATEGIES TO CONTEMPORARY OFFICE BUILDINGS IN KENYA

Lorna Kiamba, Lucelia Rodrigues, Benson Lau

University of Nottingham



The local Kenyan context and a proposal for the way forward.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

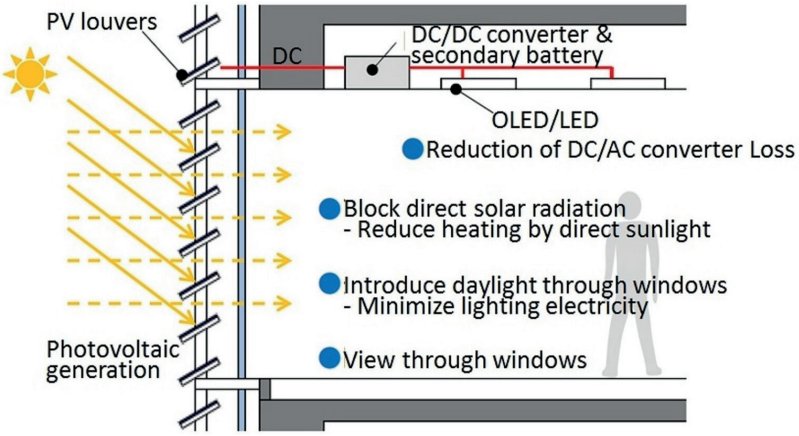
In the backdrop of globalisation and urban population growth, developing countries in tropical regions show rapid growth in electricity consumption attributed to an increase in the use of air-conditioning for space cooling. An examination of contemporary non-domestic buildings in Mombasa, Kenya revealed the predominance of highly glazed lightweight buildings which rely on costly and unsustainable active climate control systems (Fig 1). In a region inundated by unstable economic security and dwindling energy resources, there is an urgent need to explore viable climate responsive design alternatives suitable to local conditions. In a previous study on Swahili vernacular architecture, the authors revealed its suitability of plan, form and fabric characteristics and identified Swahili-inspired passive design strategies applicable to contemporary office buildings in the warm humid region. One of the key findings was the potentially significant impact of thermal mass on the building thermal performance. Subsequently, a parametric study using dynamic thermal modelling was conducted. Initially, using a simplified model, the impact of varying thermal mass properties of the building fabric was studied. Next, the dynamic simulation and parametric optimization of a selected typical office building in the warm-humid city of Mombasa was undertaken. Preliminary results showed that an increase of thermal mass resulted in lower indoor temperatures and increased comfort hours. Based on this finding, further parametric analysis taking into account other feasible environmental design solutions were conducted. The final results suggested that in warm humid regions, a combination of heavyweight thermal mass, natural ventilation (daytime and night time) and responsive sun shading could significantly improve thermal performance and comfort conditions, and subsequently lead to reduction of electricity consumption of contemporary non-domestic buildings.

KEYWORDS: *Vernacular architecture, heavyweight and lightweight mass.*

ENERGY-SAVING POTENTIAL OF BUILDING FACADE WITH INTEGRATED PHOTOVOLTAIC LOUVERS

Tomoko Tokumura, Kitoshi Tanaka, Tomohiro Kuroki, Mikio Takahashi

Takenaka Corporation, R&D Institute



Principle of PV louvers

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The authors have developed photovoltaic (PV) louvers, which are exterior structures integrated with PV cells that act as movable horizontal louvers. They help to reduce the cooling load due to direct solar radiation, in addition to the lighting load, by allowing moderate amounts of daylight to pass through the windows. The DC electricity generated by the PV louvers can be used for indoor electrical equipment. This paper reports the energy efficiency of the PV louvers, as determined by field measurements and simulations. The electricity-generating capacity and radiative environment of a PV louver mock-up mounted on the exterior of a building were investigated. The results of field measurements over a period of more than one year showed that the PV louvers were responsible for large energy savings.

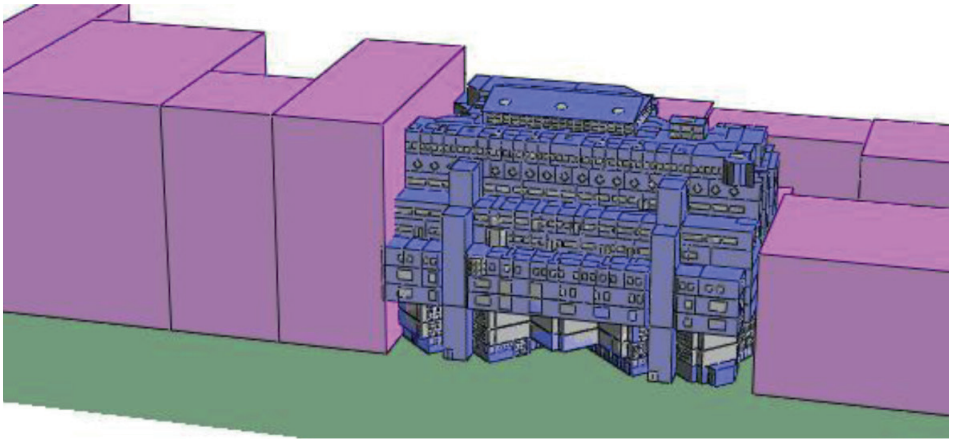
The energy-saving potential of this system was also numerically simulated. Annual energy-balance simulations were carried out, which took into account the reduction of the air conditioning load by blocking direct solar radiation, the reduction of the illumination load by introducing daylight, and the energy created by the PV cells. The results indicated that with appropriate control of the louver angle based on the time and date, the energy consumption in the perimeter zone of an office could be reduced by around 65% relative to that for a standard building without PV louvers. PV louvers, which work efficiently to reduce energy expenditures, have economic worth.

KEYWORDS: *ZEB, Photovoltaic, Exterior Louver, Louver Angle Control, Daylight Efficiency*

ENERGY PERFORMANCE EVALUATION AND PREDICTION FOR AN INSTITUTION BUILDING

James Pow Chew Wong
RMIT University, Australia

Linnea Eriksson
Karlstad University, Sweden



Simulation model and surrounding buildings

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

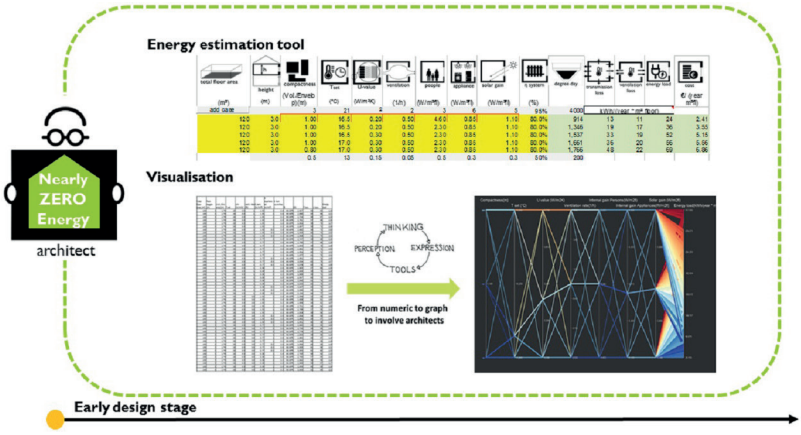
The building sector is responsible for almost a quarter of the total carbon dioxide emissions. The urgency to reduce the emissions is reflected in the stricter regulations and guidelines which have been implemented in various countries. They are two effective ways to reduce the building sector's emissions, namely constructing new energy efficient buildings or retrofitting existing buildings. Due to the life expectancy of existing building stock the greatest reduction in emissions before 2030 could be achieved through retrofits. This paper evaluates the energy performance gap between the measured and simulated results of an institution building and discussed how the computational method is contributing to the prediction of energy usage after retrofits. The case study building is a medium rise institution block with classrooms, offices, library, computer labs and cafeteria facilities within a city campus in Melbourne, Australia. A thermal simulation model of the case study building was compared with the measured energy performance of the building. The various identified retrofits were then incorporated in the simulation model and compared with the predictions calculated using a mathematical model used by the retrofit project consultant company. The energy performance gaps between the two methods were analysed. The conclusions are that the simulation model is reflecting the actual energy use of the building well. The electricity use is reflected well both in the total annual use, approximately 4% gap compared to measured value, and the monthly variation over the year. The total natural gas use is under predicting the annual energy use, approximately 40% gap to the measured value, but shows a good correlation to the monthly variation.

KEYWORDS: *Building energy performance prediction, Retrofit, Institutional building, Building simulation*

VISUALISATION TOOL TO ESTIMATE THE EFFECT OF DESIGN PARAMETERS ON THE HEATING ENERGY DEMAND IN THE EARLY DESIGN PHASES

Ayu Miyamoto, Tam Nguyen Van, Damien Trigaux, Karen Allacker, Frank De Troyer

Architectural Engineering Division, Department of Architecture, Faculty of Engineering, KU Leuven, Belgium



From numerical data to parallel coordinate visualisation

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

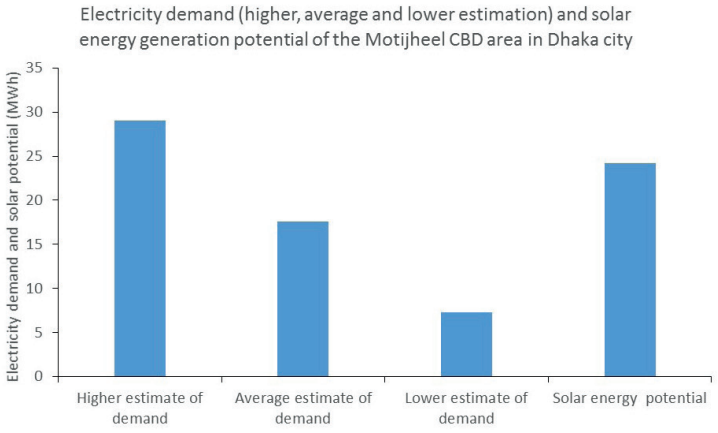
Research Summary

To date powerful dynamic simulation tools are available to estimate the energy consumption in buildings. However, these require a lot of input and generate a large amount of output data. This output has to be filtered to select relevant results for early design phases. As a consequence, early design decisions regarding energy efficiency are in practice often based on architects' experience or intuition. As architects think in a graphical way, this paper proposes a tool to visualise the effect of decisions on the heating energy demand, based on the developed "dynamic Equivalent Degree Day method". Using a macro, this tool generates automatically parameter combinations, calculates the energy use and represents results graphically. Relevant sketch design parameters can be manipulated graphically such as the thermal compactness, insulation level, the effective use of direct and indirect solar gains, internal gains including occupant presence and activities, and global ventilation strategies. It is expected that energy demand visualisation can improve the integration of energy efficient design into the architectural process from the sketch design stage onwards. In addition, visualisation is a powerful communication tool for architects to share information and ideas with other architects, engineers, stakeholders and users towards realising Nearly Zero Energy Buildings. The approach is elaborated for the Belgian context, but can be applied to other contexts.

KEYWORDS: *Parametric simulation, dynamic Equivalent Degree Day method, energy performance, early design phases, visualisation tool*

EXPLORING THE SOLAR ENERGY POTENTIAL FOR MULTISTORIED COMMERCIAL OFFICE BUILDINGS IN A DENSE CBD AREA OF A MEGA CITY

Kumar Biswajit Debnath - School of Engineering, Cardiff University
M Tahajibul Hossain, Md Nahid Iqbal - Bangladesh University of Engineering and Technology
Sheikh Md Rezwan - Daffodil International University



Electricity demand (higher, average and lower estimation) and solar energy generation potential of the Motijheel CBD area in Dhaka city

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

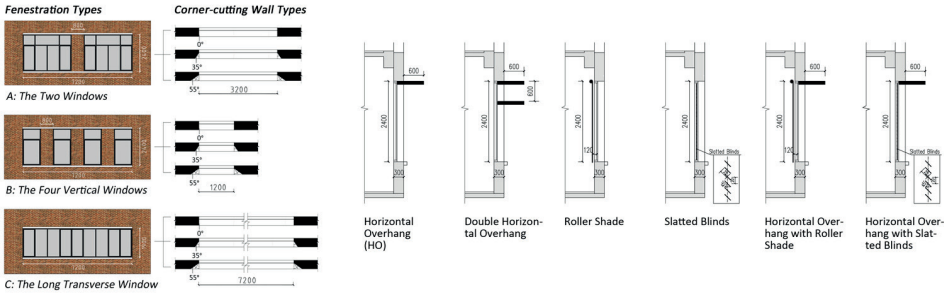
Motijheel Commercial Area, the main central business district (CBD) of Dhaka city, Bangladesh has already been found through many studies to cause urban heat island (UHI) effect due to its densely built multistoried commercial buildings and lack of green areas. These buildings consume significant amount of electricity to accommodate the lighting facilities, mechanical means for ensuring thermal comfort and operating electrical appliances for a huge number of occupants. This research seeks the potential of solar energy generation by using the prospective roof and elevation surface areas of these buildings, which takes significant part in causing augmentation of mean radiant temperature against the existing electricity consumption rate. Also, this research aims to establish a comparative analysis between existing electricity demand and the solar electricity generated to explore the potential of solar energy harvesting in a densely built urban area. In addition to it, the influence of choice in lighting technology (incandescent, florescent, CFL and LED) would be further examined to see their contribution in electricity demand. This study may contribute in policy development for the already densely built high electricity demanding commercial urban areas into self-sustaining low electricity demanding urban zones.

KEYWORDS: *Energy demand; solar energy potential; commercial office building.*

ENERGY EFFICIENT SCHOOL FAÇADE DESIGN: EFFECT OF SHADING DEVICES ON FENESTRATION FOR DAYLIGHTING IN COLD CLIMATES

Anxiao Zhang, Qiong Huang, Yanchen Sun
Yangshu Li, Yaning Mao, Tao Wang, Qi Zhang

Tianjin University



Key image: The tested classroom façade designs and shading devices

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper reports on a research exercise that utilized simulation techniques for identifying the most efficient school façade designs and their associated shading devices. Simulation of the daylighting performance and energy consumption of common fenestration designs were conducted using a series of shading devices. The paper focuses on arriving at solutions that balance between the achievement of proper daylight distribution and the reduction of energy consumption in the cold climate of Tianjin, China. The approach is exemplified using the case study of a secondary school building in Tianjin. Simulations were conducted using DAYSIM, su2ds which is a plug-in for SketchUp modelling software to interface with the DAYSIM, and DesignBuilder software.

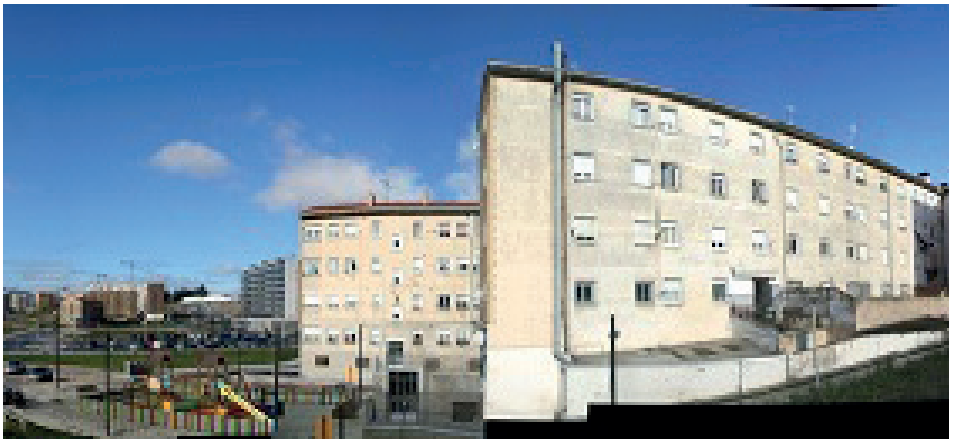
Results demonstrated that solar penetration is a critical concern affecting school façade design in cold climates. The double horizontal overhang was recommended for all three fenestration designs due to optimum daylighting and energy performance. The horizontal overhang also had sufficient daylight but a much higher glare incidence. Slatted blinds reduced glare probability in most façade designs yet had a negative effect on the energy consumption of the room. The horizontal overhang with slatted blinds applied in the two-window fenestration design had a similar energy load but a much lower daylighting level. The roller shade and the horizontal overhang with roller shade were not recommended for all fenestration designs due to inadequate daylighting all year round. On the other hand, use of the long transverse window fenestration design was found to be slightly more efficient than the others. Moreover, the corner cutting angles showed little difference in terms of daylighting and energy in most cases, especially in the long transverse window façade. [...]

KEYWORDS: *School Façade Design; Daylighting; Energy Efficiency; Shading Devices; Classroom Fenestration*

OPTIMISING ENERGY RETROFIT OF SOCIAL HOUSING BUILDINGS BETWEEN 1940-1980. REDUCING THE GAP BETWEEN REALITY AND SIMULATION RESULTS

Ana Castillejo-Celigueta, Aurora Monge Barrio, Jorge San Miguel Bellod, Ana Sánchez-Ostiz Gutiérrez

Universidad de Navarra



Studied building

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The main objective of this research is to determine, at the level of urban research, the possible error existing when doing energy simulations of a great number of existing buildings, based on the baseline data for the simulation model.
The study has been based on the inspection and analysis of 47 buildings constructed between 1940-1980, in social neighbours in the cities of Pamplona and Tudela, Navarra (Spain), performing a selection by building typology defined in the research project "prestaRener", in which this article is included. For this analysis, a diagnosis tool for the study of the current state of the façade has been designed, focusing on the state of the windows, because the most common current state of the buildings to be rehabilitated include multitude of individual modifications focused there, and those measures have a great impact in the insulation and airtightness of the dwelling, and so in the energy performance. Finally, the methodology is applied to a case study (SOLEE) in a vulnerable district (a very low socio-economic profile) of Pamplona, where have been detected cases of energy poverty, and considered a priority by Pamplona City Council. A complete monitoring and energy simulation have been performed, that includes the original state (EO-1958) on one hand, and the current state (EA-2014) on the other, and being able to verify the difference and implications that has the definition of the model according to original plans or to current status obtained from visual inspection, and in different levels of actuation. The findings of this study will help researchers to decision-making in the model for energy simulations, as well as to the orientation of the rehabilitation policies that manage local or State Governments by adjusting the equation cost benefit.

KEYWORDS: *Retrofit, social housing, simulation, energy poverty.*

SOLAR PROTECTIONS FOR ENERGY EFFICIENCY: EXPERIMENTAL COMPARISON OF FOUR COMPLEX FENESTRATION SYSTEMS CONSISTING OF LOUVERS IN A SEMIARID CLIMATE

Waldo Bustamante, Sergio Vera, Francisca Ureta, Joaquín Bustamante

School of Architecture, Pontificia Universidad Católica de Chile

Experimental set-up. Test-room N°1 to the right, Test-room N°2 to the left.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Overheating, high cooling energy demand and glare are common problems in office buildings in Santiago de Chile, where modern architecture is typified by fully glazed façades in spite of a long hot and dry season with high radiation levels. Horizontal louvers covering the entire window stand out as one of the best solutions in order to control these concerns. However, this option presents a problem of its own: it does not allow a view to the outside, which is a fact that negatively influences the building´s users comfort. The present study consists of an experimental analysis to compare how two modifications applied to the louvers – which enables the fenestration system to allow for an outside view – influence the thermal and lighting performance. The result is that Modification (a): removing every other louver, has a considerable negative impact on performance, reducing it between 18% and 27%. Whereas Modification (b): adding perforations to the louvers, stands out as a great option, reducing performance for only around 2% and 8% while allowing a view to the outside. This information could be helpful for designers in the early building design stages.

KEYWORDS: *Louvers, thermal performance, lighting performance, office buildings, semiarid climate.*

DEVELOPING ENVIRONMENTAL PRACTICES FROM ARCHITECTURAL AND SOCIAL ASPECTS IN THE CASE OF DUBAI

Dania-Tachouali, Hasim-Atlan

The British University in Dubai

Dubai plan 2021 elements (TEC Government of Dubai 2014)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Architecture plays a significant role in improving the quality of life by reducing the CO2 emissions, according to the world life fund of nature 2010, the UAE was ranked the first with the highest ecological footprint. Dubai Plan 2021 is a key inspiration to adopt new strategies and to find new solutions for social, environmental and economic challenges in the region. The paper is aiming to achieve two of the Dubai Plan 2021 elements (the Society and the Place). Starting with the architectural aspect as Dubai is witnessing a fast growth in architecture, the aim is to build up holistic guidelines to bring the threads of sustainability to Dubai, achieving the right practices for the architectural aspect that can pave the way towards a city of happy and satisfied people. Continueing with the architectural aspect (the Place), three innovative strategies have been suggested that can help in reducing CO2 emissions on both long and short terms, integrating few workplaces with residential areas; reusing construction waste and creating sense of place. Yet again, the solutions given for the social aspect (the Society) varies between theoretical and conceptual framework, integrating media tools at the right areas; creating strategies for visioning and education's role in enhancing awareness of social issues. This paper discusses the results to demonstrate how this will add value and help in achieving the highest standards of a clean environment to face the challenges of today, and possibly tomorrow.

KEYWORDS: *Sustainable Built Environment, Dubai Plan 2021, Innovative Solutions, Climate Change, Global Warming, Sustainability.*

A STUDY INTO THE INTERNAL ENVIRONMENT OF AN ETFE PANEL STRUCTURE: EVALUATION OF THE THERMAL AND LIGHTING PERFORMANCE IN A TEST STRUCTURE AT GRANTHAM, UK

Benjamin Martin, Benson Lau, John Chilton, Paolo Beccarelli

University of Nottingham

ETFE test structure located outside Grantham, UK

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper investigates the thermal properties of an enclosed Ethylene Tetrafluoroethylene (ETFE) structure based on on-site monitoring over set periods of time in summer and winter. ETFE is a relatively new material that has been used in some high profile projects around the world. ETFE structures have many benefits such as good light transmission and high mechanical strength. In addition the material is light weight and has a long life span. ETFE is also useful for horticultural applications as it is transparent to the majority of UV light so crops underneath the ETFE enclosure can be protected as well as benefit from UV light.

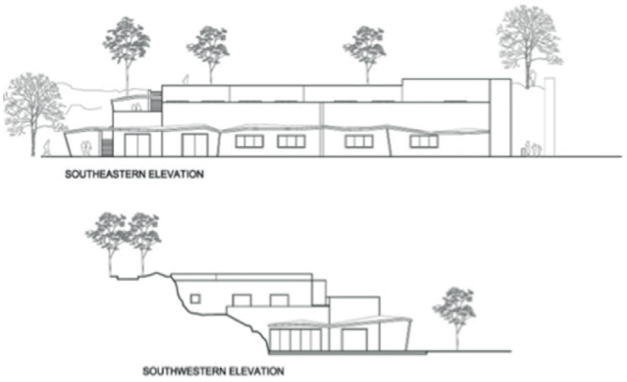
This research project makes use of a new tensioned modular ETFE panel that look and can be installed similar to glazing. This new system opens up new architectural and horticultural potentials for using ETFE panels. An ETFE test structure was constructed from the ETFE panels and this paper presents the impact of the solar radiation on the thermal environment within the structure so that a more holistic understanding can be obtained. An analysis of the illuminance within the structure was undertaken to evaluate the impact of the materials transparency on the solar radiation within the structure and thermal images were used to understand the impact of the material and structure for heat loss. The research results show that without the means to allow natural ventilation, the temperature within an enclosed ETFE structure can become too high during the summer months and in the winter months, it may require heating. However, the overheating and under heating issues can be resolved through selective shading. Lessons learnt from this study highlight the potential of using ETFE panel as a desirable and workable alternative to other materials particularly in areas of plant growth.

KEYWORDS: *ETFE Structures, Light Weight Structures, Modular Construction, Thermal Evaluation, Lighting Assessment, Building Performance*

LOW ENERGY CIVIC CULTURAL CENTER IN A SMALL ISLAND OF AEGEAN SEA, GREECE

Iro Nikolakea

In Architects



Building Elevations

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The building is a new Civic Cultural Building in an small island of Dodecanese area in South Aegean Sea in Greece, the island of Lipsi, with a population of no more than 700 people who live through agriculture, fishing and tourism. The island is pioneer in "green island" policy in Greece through the extensive use of renewable energy sources and extensive recycling alongside the employment of traditional techniques in the local resources exploitation of wine producing, apiculture, fishing etc.
In this broader framework of "green lipsi", the new civic cultural building has been designed on the local vernacular architecture guidelines in order to fulfill the objectives of energy conscious design, integration of renewable energy, sustainability of local community etc. The innovative construction of the Civic Cultural Centre will comprise the use of low energy materials as well as recycled materials based on the principle of zero waste. The building exploits alternative energy sources for heating, employs traditional passive cooling techniques, minimizes almost to zero the use of fuel, uses low consumption M/E installations and implements high thermal insulation practices. It will possess a high ecological footprint, a high degree of autonomy with minimum energy and water consumption and it will provide a friendly and comfortable environment. Additionally, the building educates the user behavior for a high energy performance result.
The new Civic and Cultural Center of 1600sq.m., consists of a multi use auditorium for 300 people which will be linked by an open foyer to the open exhibition areas in the lower floor. It also accommodates spaces for studying, meeting, working and recreation through the book and multimedia library as well as the music, drama, dance and rehearsal rooms and the generous enclosed and open cafe areas.

KEYWORDS: *PASSIVE AND LOW ENERGY DESIGN, SUSTAINABILITY OF LOCAL ISLAND COMMUNITY, USER EDUCATION*

DIVIDE BY NET-ZERO: INFINITE POTENTIAL OR CALCULATION ERROR? A QUASI-ACADEMIC DESIGN AND CONSTRUCTION PROJECT IN INDIA

Prasad Vaidya - CEPT University, Ahmedabad, India

Rajan Rawal, Sanyogita Manu, Yash Shukla - Centre for Advanced Research in Building Science and Energy, CEPT University, Ahmedabad, India

Virtual images of CEPT Net Zero Energy Building, Ahmedabad, India

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This paper traces the design and construction process of a net-zero energy building (NZEB) in a university campus in India. Climate resilient, high performance building design warrants an integrated and iterative design process with front-loaded analysis to arrive at an optimized solution. The building discussed in this paper is designed to work as a living-laboratory where the architectural elements and systems components are designed with flexibility to allow for experimentation with systems and operations. A team formed under a US-India bilateral project with expert consultants from across the world and local consultants' experienced in execution proposed a highly optimized and context-appropriate solution. A master architect, a design, construction and occupant-cum-commissioning team, other consultants, and equipment and material suppliers worked together to evolve the building design. The design of the comfort and energy monitoring systems for the building form an important demonstration of the collaboration between academia and industry which is not typical in India. The building serves as an example of the challenges and opportunities that integrated design offers and this paper elaborates on some of the important lessons for all stakeholders – architecture students, professionals, researchers and industry, who are going to play a vital role in the making of high performance buildings in future. The paper highlights the experiences during the design detailing, construction and equipment sourcing, that prove challenging to smaller NZEBs in developing economies.

KEYWORDS: *NZEB, High performance buildings, Integrated design process, Developing economies, India*

ENERGY CONSERVATION AND RECYCLING OF CONSTRUCTION ELEMENTS IN BUILDINGS

Fernando Barth, Luiz Henrique Maccarini Vefago

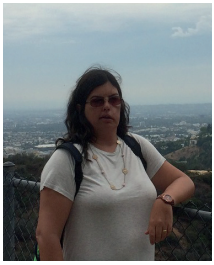
Federal University of Santa Catarina

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The ancient architecture was designed and built to last thousands of years. Materials were simple, some of them like stones could be reused, and others like iron could be recycled in the way to optimize the natural resources. Nowadays, the temporal dimension in the design and construction of buildings has become the phenomena that have changed the perception of the time in architecture. Buildings have a lot of embodied energy in their materials, using many composite materials that complicate the recycling. The construction industry in Europe demands 40% of the total energy produced and generates 40% of all the waste produced on the continent (CIB, 1999 and EU, 2010). The conventional building is mostly demolished after the end of its life cycle and the embodied energy of its materials is not preserved. The aim of this paper is to analyse how energy can be preserved inside building materials using the recyclability of existing elements and to show how it can improve the sustainability of building construction. The method of this paper is based on international references about the theme and is focused in some case studies about design for deconstruction (CIB 2001a and CIB 2001b). The calculations of the Index of Recyclability (Vefago and Avellaneda, 2013) shows the quantity of materials reused or recycled incorporated in the new building. The results of this paper show that the Index of Recyclability and the Design for Deconstruction must be incorporated in the building design phases, in the way to not only make sure its assembly, but also ensure the maximum possible energy conservation in the building elements after its deconstruction.

KEYWORDS: *Energy, recyclability, deconstruction, reuse, recycling, building,*



THERMAL AND VISUAL PERFORMANCE OF REFLECTIVE WINDOW FILMS AND REFLECTIVE GLASS

Lucila Labaki, Carla Matheus
UNICAMP

Rosana Maria Caram
USP

View of the test-cells and spectrophotometer

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

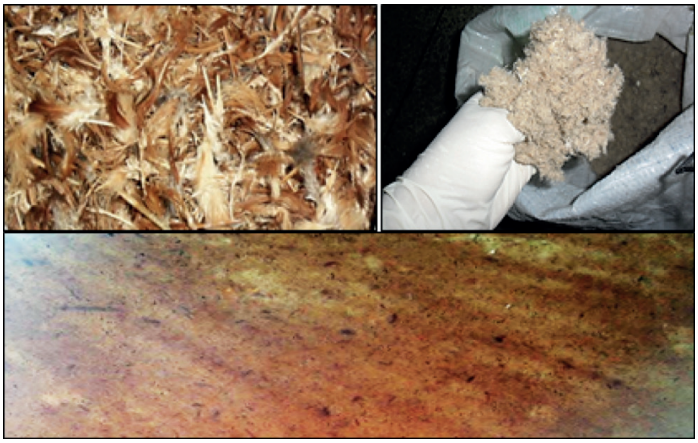
The use of transparent materials in building façades brings about the concern about environmental comfort and energy consumption control, since glazing easily allows the penetration of solar radiation into buildings, which is a major concern in tropical countries. A study of the properties of solar radiation transmission through polymeric reflective window films and reflective types of glass is presented and the thermal behaviour of these materials is analysed in real climatic conditions. The optical behaviour of such materials in the different ranges of the solar spectrum: ultraviolet, visible and infrared, as well as their performance concerning thermal comfort and daylighting are discussed. Experiments were carried out using a Hitachi spectrophotometer, ranging from 300 to 2500 nm. Films were installed in common colourless glass, separately at North and West façades of test-cells built in the southeast region of Brazil. The method consisted in measurement of indoor temperature in the cells and internal surface temperature of the windows. Non-reflective solar control films are highly transparent to infrared radiation and less to visible light. Reflective films present low transmission to infrared and to visible light. Results show that the highest solar heat gain among coloured materials was through reflective bronze film among the coloured materials. Moreover, films installed in glass in North oriented façades show stronger solar heat gain than those in West oriented façades.

KEYWORDS: *ENVIRONMENTAL COMFORT, BUILDING ENVELOPE, POLYMERIC WINDOW FILMS, REFLECTIVE GLASS*

ALTERNATIVES FOR THE BUILT ENVIRONMENT: THE FEASIBILITY USE OF CHICKEN FEATHERS AS CONSTRUCTION MATERIAL

Fernanda Aparecida Alonge
Paula Valéria C. Chamma

Unesp – Universidade Estadual Paulista "Julio de Mesquita Filho" – Campus Bauru



Chicken feathers and plastic and chicken feathers plastic composite panel

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

The changes in society, population growth and the current demand for construction have been a motivation for research on built environment. The building materials cause environmental impacts in the productive process and in the life cycle of a building. Each day, new building materials are launched and the challenge is to create viable materials in economic and environmental aspects. Organic materials such as feathers, skins and bones of animals or plant fibers that have been discarded in the environment can create alternative materials. The production of poultry for human consumption create waste, such as the chicken feathers, that after the slaughter are incinerated or used for the increment in their own animal feed, even without any nutritional value. More appropriate destinations can be given for this residue, such as a building material, the purpose of this research. This paper describes the methodology used to produce a sustainable material, developed by the use of plastic and an agronomical residue, in other hands, the production of a panel made by virgin plastic polypropylene (PP) and chicken feather. So, the objective was to produce a composite with physics and mechanics properties appropriate to the role they can perform. From the process of extrusion and pressing of this material, we got an alternative product of high density, suggested for many uses in the field of construction, such as architectural element.

KEYWORDS: *Panels; construction; chicken feather; sustainable; residue*

'15 PLEA

Architecture in (R)Evolution

Bologna, 9-11 September

+ Resilience – Vulnerability

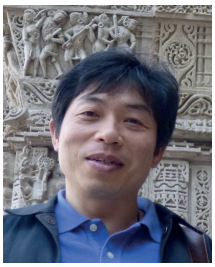
3rd Parallel Session

DAY 2

14:00 – 16:00

CHAIRMEN

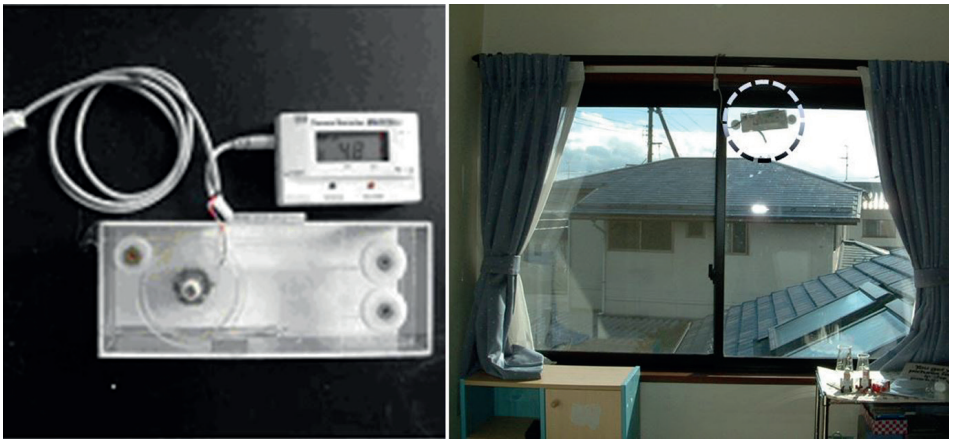
Alessio Battistella ..... Table 11
Valentina Resente ..... Table 12



EFFECT OF INDOOR AIR TEMPERATURE ON WINDOW OPERATION IN DETACHED HOUSES IN JAPAN

Masanori Sugawara
Miyagi University of Education

Motoya Hayashi
National Institute of Public Health



Opening width monitor at a sliding window

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

During the hot and humid summer conditions experienced across most of Japan, sun shield and/or natural cross ventilation are basic approaches that can be used to improve indoor conditions without increasing energy consumption. However, inhabitants open windows not only for ventilation, but also as a routine practice. To determine the properties and factors that affect opening/closing of windows, we measured the seasonal variations in indoor/outdoor conditions and the width of window openings in detached houses distributed between Hokkaido and Shikoku, Japan. The window opening time rate [min/h] was defined as the monthly average of the window opening time, calculated for each hour of the day.

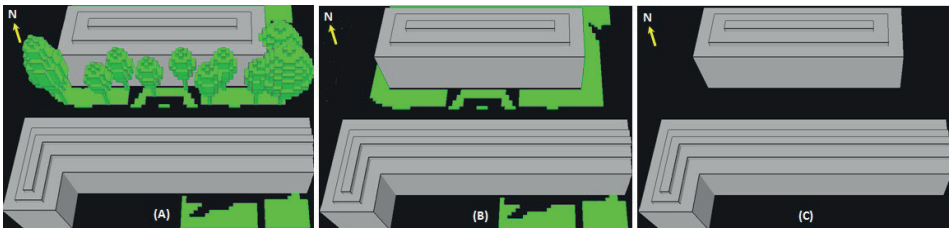
When the room air temperature was low, window opening time rates tended to be 0 min/h, but as the temperature increased, window opening rates also increased to up to 60 min/h. As window opening time rates increased relative to the room air temperature, the slope became steep around a particular temperature. That is, the relationship tended to produce an S-shaped curve. We applied a regression equation using a cumulative Gaussian distribution function to develop a formulation. The average temperature [°C] was the room air temperature corresponding to both the most rapid change and to a window opening time rate of 30 min/h. The standard deviation [°C] is a measure of the flatness of the rate of change of the window opening time rate at the average room air temperature. Living rooms showed almost the same averages and standard deviations; however, the differences observed depended on the number of people in the household and on the region in which the house was located.

KEYWORDS: *Environmental adjustment, Window opening width, Cross ventilation*

GREEN COVERAGE CHANGES WITHIN AN ESE-WNW STREET CANYON AS A PLANNING MEASURE TO MAINTAIN HUMAN THERMAL COMFORT ON A HEAT WAVE DAY

Hyunjung Lee, Helmut Mayer

Freiburg University



Cases A, B and C for numerical simulations on the impact of green coverage changes on human thermal comfort within a street canyon in the city of Freiburg (Southwest Germany)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

For urban planning in Central Europeans cities, the intensification of severe summer heat, which will be typical of the future summer weather in Central Europe, represents a significant challenge. Long-term planning measures based on current knowledge of urban human-biometeorology are necessary in order to maintain outdoor human thermal comfort on the local urban scale during this meteorological hazard. The simulations of the impacts of green coverage changes (three cases) on human thermal comfort described in this study provide valuable basic information for these planning measures. As the simulations were conducted for an ESE-WNW street canyon in Freiburg (Southwest Germany) on a heat wave day, they concern an urban structure, where severe daytime heat stress for pedestrians is longer lasting and particularly marked at the SSW-facing sidewalk. Due to continuous shading by a building, the NNE-facing sidewalk shows a distinctly lower heat stress level for pedestrians in the daytime.

The simulation results for three cases of different green coverage are related to mean values (10-16 CET) of near-surface air temperature, mean radiant temperature and physiologically equivalent temperature. They quantify to what extent and where human heat stress is reduced in this typical urban structure by existing trees and grassland surfaces. With respect to lowering human heat stress for pedestrians in the daytime, adult trees are more effective than only grassland. The area, which benefits from their shading of the direct solar radiation, depends on the location of trees, their distance, their canopy dimensions and the position of the sun.

KEYWORDS: *GREEN COVERAGE CHANGES, STREET CANYON, HUMAN THERMAL COMFORT, HEAT WAVE DAY, ENVI-MET SIMULATIONS*

NATURAL VENTILATION POTENTIAL FOR RESIDENTIAL BUILDINGS IN ALEXANDRIA - EGYPT

Bakr Gomaa

Arab Academy for Science and Technology

The City of Alexandria. Source Apple Maps

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

Natural ventilation is an important aspect of energy conservation in buildings. Alexandria of Egypt is blessed by the persistent cool wind of the Mediterranean Sea and cursed with large stock of residential buildings that are dependent (for long times of the year) on air conditioning systems. Such economic and environmental waste is driving this research, in which the role of the existing urban fabric, and the city's climate is studied to define the possibility of natural ventilation development in the different parts of the city. The research methods define the common urban fabrics in the city, and CFD is used to explore their impact on the pressure differential and wind speed in inner city and waterfront regions. This research catalogues the impact of the city design on natural ventilation potential in residential buildings. The research concludes in a clear definition of the ideal and poor city fabrics in terms of natural ventilation potential; a definition that highlights for designers, developers and city planners, the impact of the different urban fabrics on the windows size requirements. It is believed that these results should open the debate about how Alexandria's fabric should grow and develop, and how the associated building facades should be designed.

KEYWORDS: *Natural Ventilation, Alexandria, Egypt, Urban Fabric, CFD*

TEMPORARY SOLID WASTE TREATMENT IN POST-EMERGENCIES

Valentina Resente, Sara Bellavita, Caludia Prestia, Federico De Nardo

Studioazue

the facility under construction, Ghazze (Lebanon 2014-5)

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

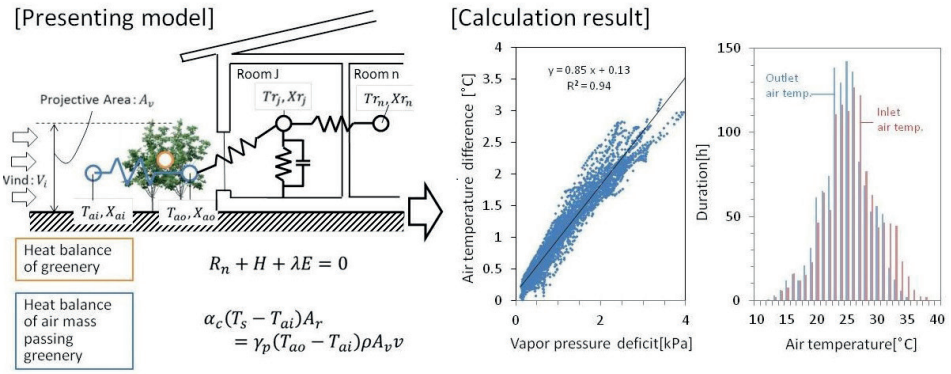
The solid waste treatment facility conceived by studioazue for Oxfam with funds granted by DFATD Canada (Department of Foreign Affairs, Trade and Development) is a pilot project designed to be temporary, replicable and transferable, to serve the Syrian informal refugees camps located in the Beqaa Valley (Lebanon). The facility has been constructed using 17 freight containers ISO standard as structural modules, assembled to create a space of approximately 375 square meters to accommodate two separate waste treatment cycles. The absence of foundations gives the opportunity to set up rapidly the facility in line with the requirements of any emergency response, as well as it prevents the degradation of agricultural land. Once the emergency situation will be over, the building can be easily decommissioned, dismantled and removed. The conception of building envelop matches the content: it valorises second hand containers making new use of them, hence translating into an architectural space the end-of-waste concept. The growing number of Syrian refugees in Lebanon and the associated adverse impacts on the environment and the economy are causing social conflicts between the displaced and the hosting community. The provision of a solid waste treatment facility to serve the camp, contributes on one side to lessen the environmental degradation, on the other to create new income opportunities for the refugees. The conceived idea, as matter of sustainability, is the result of an informed intuition, catalyst of communities (refugees and hosting) needs and an innovative interpretation of informal solutions put in place by refugees (Hamdi, 2014). Far to be linear, the design process consisted in networking assets and opportunities identified through an attentive context analysis and the direct involvement of the community.

KEYWORDS: *WASTE MANAGEMENT, FREIGHT CONTAINERS, HUMANITARIAN-AID, URBAN CRISES, REFUGEES AND INTERNAL DISPLACED PEOPLE*

PASSIVE COOLING FOR INDOOR CLIMATE BY EXTERIOR GREENERY AND NATURAL VENTILATION: EXPERIMENTAL AND NUMERICAL APPROACH

Hidenori Kawai, Takashi Asawa, Teru Nemoto, Taechol Lee - Tokyo Institute of Technology

Rihito Sato, Yukari Hirayama, Isamu Ota - Misawa Homes Institute of Research and Development Co., Ltd.



Outline of numerical simulation model and cooling potential by greenery during summer 50 days

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

This study focuses on the building design which improves the microclimate around building envelope by greenery and evaporative cooling technique. In the building design, greenery is located in front of the window for natural ventilation. In this study, the decrease of air temperature as a cooling potential of the greenery during summer 50 days is shown.

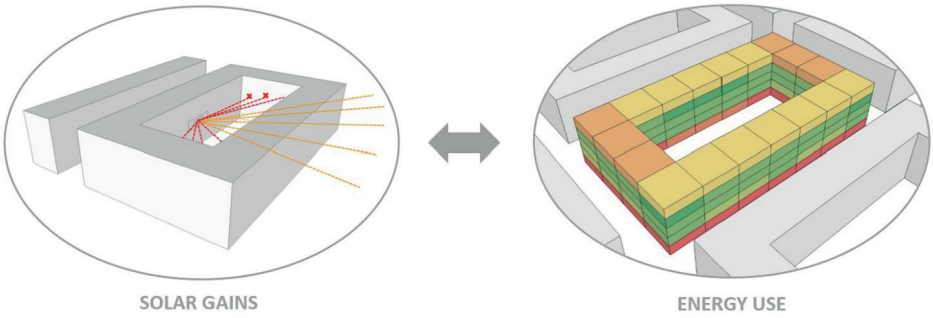
First, in order to predict the passive cooling effect of the greenery over a period of time, numerical simulation method is presented. In the microclimate prediction model, the air temperature and humidity around the window is predicted by solving the heat balance of greenery and its surrounding air. Then, as a result of measurement, it is confirmed that the convection heat transfer coefficient and drag coefficient of greenery is identified and expressed as a linear function of wind velocity. Moreover, the cooling potential of greenery for 50 days is predicted by the verified numerical simulation. As a result of the prediction, the duration of air temperature over 28 °C decreases by approximately 2 hours/day. Then, the decrease of air temperature in south wind condition, which is high water vapor condition becomes 3 times of that in northwest condition.

KEYWORDS: *Natural ventilation, Greenery, Evaporative cooling, Building thermal simulation, Air flow network*

A DESIGN TOOL TO OPTIMIZE SOLAR GAINS AND ENERGY USE IN NEIGHBOURHOODS

Damien Trigaux, Bernard Oosterbosch, Karen Allacker, Frank De Troyer

KU Leuven, Department of Architecture



Design tool for the optimisation of solar gains and energy use in neighbourhoods

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

In cold and moderate climates, the optimisation of solar gains is an important issue to answer the challenge of reducing energy expenditures in buildings. During the master planning of neighbourhoods, design decisions related to the urban layout and geometry can affect the availability of solar radiation considerably. However the impact of those decisions on the heating energy consumption is often neglected because of the lack of appropriate energy simulation tools.

This paper proposes a simple design tool to optimise solar gains and energy use during the master planning phase of neighbourhoods. Using a plugin, implemented in the 3D modelling software SketchUp, detailed information on solar obstructions is extracted from a 3D neighbourhood model. This information can be visualised on sun-path diagrams and linked to a simplified calculation method to assess the neighbourhood energy consumption. Simulations of an urban building block with the developed design tool show a good level of correspondence with results based on more advanced calculations with EnergyPlus.

KEYWORDS: *3D environment, solar obstructions, sun-path diagrams, solar gains, energy use.*

ARCHITECTURE AND TECHNOLOGY – A LIFE CYCLE ASSESSMENT PERSPECTIVE ON SELF-SUFFICIENT BUILDINGS

Dipl.-Ing. Patricia Schneider, Prof. Dr.-Ing. Werner Lang

Technische Universität München

Design Options for the "Hochwildehaus"
(from left to right: "shelter", "lighthouse", "rock storage")

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

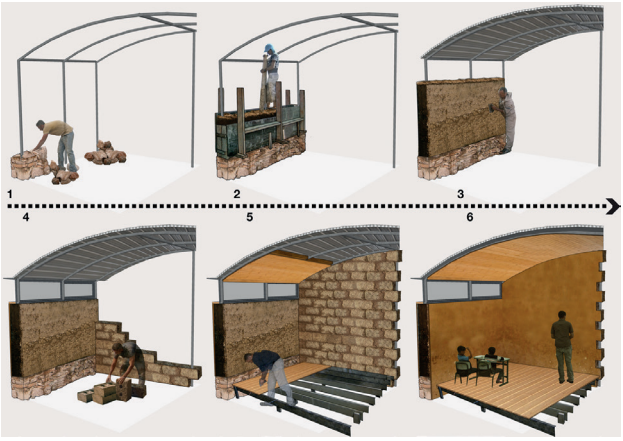
One of the major challenges of today is to provide comfortable and architecturally enjoyable living conditions to people in remote sites without a supply grid for electricity, heat and water. The results of this study can be applied globally to such self-sufficient projects trying to exclusively use renewable energy. By analysing three alternative designs for an Alpine hut, we are looking for the optimum combination of architecture and renewable energy supply for off-grid situations from a life cycle perspective. By applying a comparative life cycle assessment (LCA), we analysed the role of energy generation. As the building will be powered exclusively by renewable energy, environmental impacts caused directly by building operation will be minimized or eliminated. However, the construction and replacement of the systems for energy supply cause significant environmental impacts, especially because their duration is limited due to the extreme alpine environment. Therefore the best choice is to minimize the size of the system by providing well-insulated buildings. However, comparing the overall results of our LCA for all three design choices it becomes clear that the large share in environmental impact of energy systems in comparison to the building skin allows for a wide range of design choices: Even if a design might be slightly less favourable from an environmental point of view because of a more generous and therefore less compact spatial concept, this can be offset by a carefully chosen energy system.

KEYWORDS: *Life cycle perspective, off-grid buildings, Renewable energy integration*

NEW WAYS TO DESIGN IN EMERGENCY
A SUSTAINABLE APPROACH TO REFUGEE CAMP DESIGN

Alessio Battistella, Marco Buonocore

ARCò società cooperativa



Improvement of an emergency structure in Ramadin Al Janub, West Bank. Design by: ARCò.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

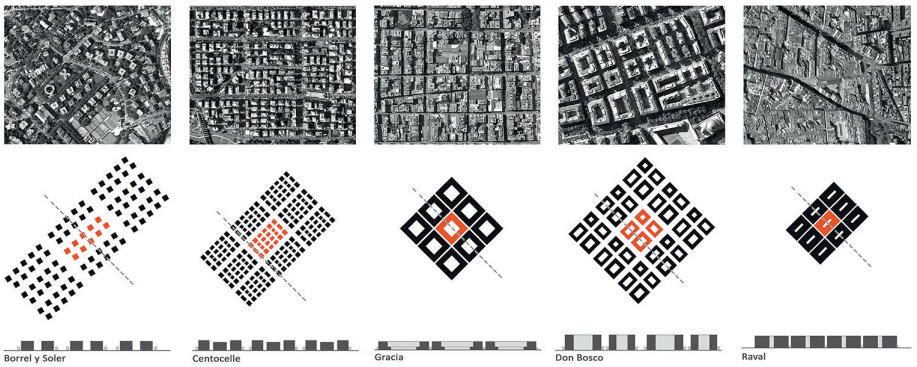
Today's conflicts and natural disasters force people, more than ever, to leave their homes and search for shelter out of their familiar environment. The displacement generates lots of pressure, not only on people, social structures or the humanitarian community, but also on natural resources and the environment. This is why the proposed paper aims to promote an ecological approach to the conception of refugee camps. In a crisis situation, displaced communities need to search for and establish themselves in a new territory in an extremely short period of time and with the constraint of leaving everything behind. This circumstance leads us (architects) to look for solutions that will consider and combine community's knowledge and culture, local and external materials, and the ecological context in which the camp is hosted. Our main purpose is to imagine a development scenario where not only environment is not damaged, but also plays an active role in the sustainable growth of the camp. This will ease the development of a durable solution and make the community resilient to its previous state. Within the paper we start by establishing a requirement: That for different ecological areas different solutions must be found, according to available resources and the capacity of the territory to support human settlements. We believe that ecological diversity can promote a new way to conceive refugee settlements, promoting their integration in the environment.

KEYWORDS: *REFUGEE CAMP, ECOLOGY, TRANSITIONAL SETTLEMENT, RESILIENCE, LOW-TECH, SUSTAINABILITY*

URBAN MORPHOLOGY AND ENERGY PERFORMANCE: THE DIRECT AND INDIRECT CONTRIBUTION IN MEDITERRANEAN CLIMATE

Agnese Salvati, Carlo Cecere
Sapienza University of Rome

Helena Coch Roura
Universitat Politècnica de Catalunya.BarcelonaTech (UPC)



Urban textures and digital models

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

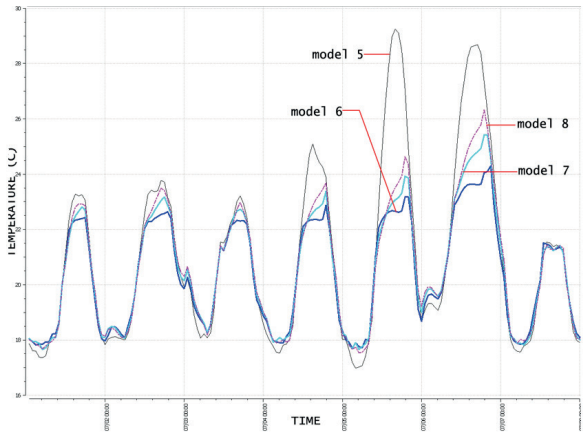
The combined effects of urban heat island (UHI), urban population growth and energy overexploitation are undermining the safety of urban areas. Urban morphology plays a prominent role in this context, because it affects building's energy demand and local climate at urban scale. However, this contribution is recurrently neglected. The present contribution seeks to investigate the direct and indirect effect of urban morphology on buildings energy performance in the Mediterranean climate. Urban morphology affects energy demand by modifying two relevant variables: outdoor air temperatures and incident radiation. The relevance of these effects were studied on a sample of urban textures of Rome and Barcelona. The study is parametric in approach. The textures were modelled and parameterized and their performances were compared. The UHI in different urban textures was calculated, by Urban Weather Generator tool. Then a sensitivity analysis of the building energy demand to the outdoor air temperatures and the incoming solar radiation was carried out, by EnergyPlus engine. Results confirm the relevance of urban morphology to the UHI intensity. Warmer temperatures lead to an average increase of energy demand from 10% to 35%, according to different urban densities. At the same time, the incident radiation reduction due to urban obstruction is desirable in Mediterranean climate; it allows a reduction of annual energy demand up to the 19% compared to an unobstructed environment. Therefore, relevant errors may occur if urban morphology's contribution to energy demand is neglected, approximately 89% for space heating and 131% for space cooling calculations, depending on the texture density and the building orientation.

KEYWORDS: *Urban Morphology, urban textures, energy performance, Urban Heat Island*

THE LCA IMPACT OF THERMAL MASS ON OVERHEATING IN UK UNDER FUTURE CLIMATES

Asif Din, Luisa Brotas

London Metropolitan University



Effect of thickness of thermal mass on interior temperatures

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

There is a growing awareness of the impact climate change in the built environment. Designers are often concerned with immediate impacts on buildings and this is reflected in the use of cradle to gate data in building Life Cycle Analysis (LCA). Likewise, the industry has promoted the adoption of certain materials on the grounds of their performance in Environmental Product Declarations (EPDs). Under these current methods of assessment timber has a high negative rating (good performance) due to carbon sequestration. However, the use lightweight construction technologies may increase the risk of overheating in buildings which will require cooling and can result in more reliance on active systems in comparison to heavyweight constructions. Previous research did not assess the importance of thermal mass in line with new overheating criteria, defined in CIBSE TM52 (Hacker, 2008; CIBSE, 2013). In this paper a single model is analysed with dynamic simulation using climate predictions in order to compare various levels of thermal mass coupled with natural ventilation. Results are presented in terms of hours of overheating and Green House Gas (GHG) emissions by predicting when active systems are likely to be required for the different scenarios. The analysis suggests that thermal mass can reduce peak temperatures by 5oC and delay the onset of the use of air conditioning by up to 30 years. These results emphasise the importance of the evaluation of operation phase of buildings within a whole Life Cycle Analysis study.

KEYWORDS: *LCA, thermal mass, Overheating, Future Climate*

ASSESSING URBAN PLANNING RESILIENCE TO OUTDOOR AIR POLLUTION IN GREATER PARIS

Jean-Marie Cariolet, Morgane Colombert, Marc Vuillet

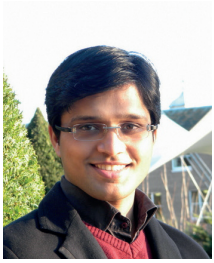
EIVP

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

A recent study reports that in 2012 around 3.7 million people died as a result of outdoor air pollution exposure (WHO, 2014). Cities are considered as hot spots and urban populations are particularly exposed. There is therefore an urgent need to adapt urban systems to improve air quality. While most European countries have put in measures to reduce emissions, actions still need to be done to reduce concentrations and exposure, and a holistic approach need to be conducted. The concept of urban resilience, defined by Holling (1987) as the ability of a city to absorb a disturbance while maintaining its functions and structures, may offer a new paradigm to tackle urban air pollution. We propose to adapt the concept of urban resilience to outdoor air pollution. A method has been developed to assess the resilience of urban systems to air pollution. Three capacities have been identified to study this resilience: the capacity of an urban system to decrease air pollution emissions, the capacity to decrease concentrations and the capacity to decrease exposure. This approach is based on the performance of the urban system at the city scale and focuses on an urban planning dimension. For each capacity, indicators are calculated in a Geographic Information System using a grid-based approach. This method has been implemented in the area of Greater Paris within a 500m grid. Greater Paris is one of the densest urban areas in Europe, and still experiences high air pollution levels. Initial results point out some issues and will help to find solutions to be implemented in order to improve the resilience of the Parisian metropolis in the future regarding air quality.

KEYWORDS: *Urban resilience, urban planning, outdoor air pollution, GIS*



STRAW BALE CONSTRUCTION: A STUDY OF THERMAL PERFORMANCE AND CLIMATE SUITABILITY IN INDIA

Hara Kumar Varma Namburu
The Energy and Resources Institute

Santhi Sree Nadimpalli
Jurong Consultants (India) Pvt Ltd

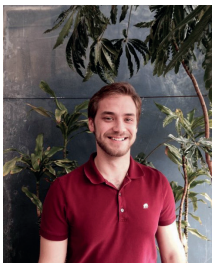
Straw Bale

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

There is a lot of innovation coming up in building materials from waste, as it not only reduces the embodied energy but also saves materials from going into landfill. Straw bale is one such rapidly growing construction material used in many parts of the world and is being accepted in construction codes of some countries for its unique thermal properties, energy efficiency and affordability. India, being an agricultural nation, produces millions of tonnes of straw as waste every year, most of which is being burnt resulting in adverse effects like production of greenhouse gases, depleting the quality of air, and loss of soil nutrients. This paper investigates the use of straw bale for construction and its suitability to the climatic context and material proximity in India. Thermal simulations were performed for a typical residential unit of evaluate the thermal performance in comparison with the conventional walling materials like burnt brick, concrete block and aerated concrete block. Adaptive thermal comfort conditions achievable with straw bale as per ASHRAE-55 were also computed. The results indicate that straw bale construction is thermally effective in hot-dry, composite and cold climatic zones in India. The material is briefly evaluated for its cost effectiveness and is found to be highly economical than conventional walling materials. The research concludes that employing straw bale in construction can be a cost effective alternate for existing construction practices in affordable housing with better thermal and energy performance. The easy availability and reduced construction costs can also benefit in providing housing needs, especially for economically weaker sections and low income groups.

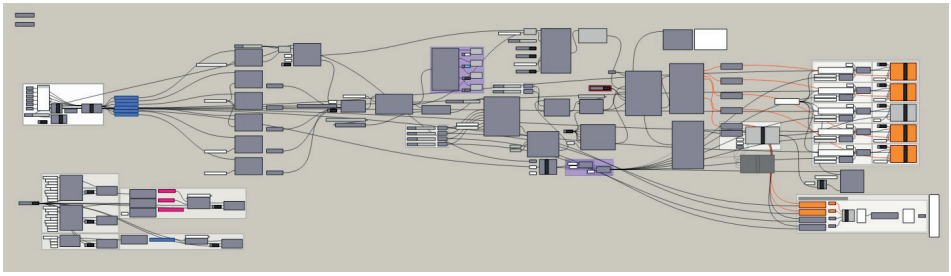
KEYWORDS: *STRAW BALE, CLIMATE, THERMAL COMFORT, THERMAL PERFORMANCE, AFFORDABLE HOUSING*



A SIMULATION STUDY QUANTIFYING THE POTENTIAL ENERGY SAVINGS ACHIEVABLE THROUGH REACTIVATING PASSIVE FEATURES IN PRE-1950'S BUILDINGS IN LOS ANGELES

Geoffrey Becker, Marc Schiler, Kyle Konis, Anders Carlson, Douglas Noble - University of Southern California

John Lesak - Page & Turnbull



Simulation workflow

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

To achieve mandatory climate goals, California buildings must become 40% more energy efficient by 2030 (Long 2011). Because a large portion of the existing commercial building stock in Downtown Los Angeles was built before 1950 and originally designed using passive strategies for environmental management, a retrofit approach is needed which harnesses the energy reductions and comfort benefits achievable through re-activation of these original strategies.

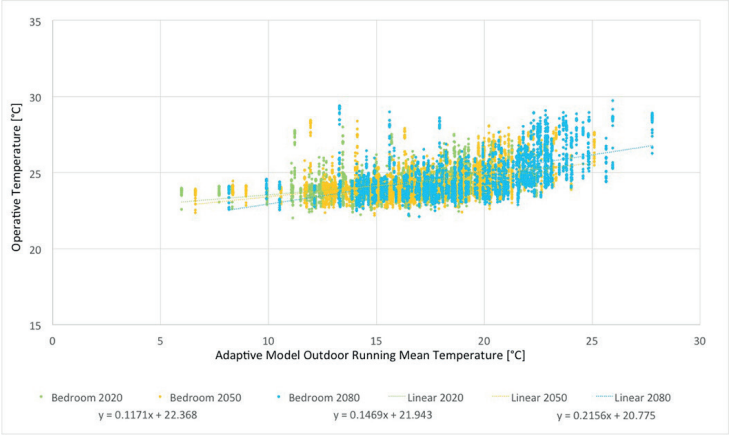
To address this need, a simulation-based framework was developed to assess annual energy and Indoor Environmental Quality (IEQ) outcomes from re-activation of multiple passive strategies. An assessment of area buildings was used to develop the initial baseline model and reconstruct original passive strategies for daylighting and natural ventilation. Simulations using EnergyPlus and Radiance quantify annual performance outcomes of retrofit combinations that replicate and improve upon the passive design intent of the historic building type. The best set of passive retrofits was found to yield an EUI reduction of 29%. A parametric model was developed to extrapolate the potential of re-activating passive strategies for additional historic buildings. Analysis of the metric thermal autonomy revealed that thermal comfort conditions can be for large periods (up to 67%) of occupied hours utilizing only passive conditioning. Analysis of the metric daylight autonomy revealed that spaces could be effectively daylit for up to 61% of occupied hours, depending on solar orientation.

KEYWORDS: *PASSIVE, HISTORIC, THERMAL AUTONOMY, DAYLIGHT AUTONOMY, ENVELOPE*

ADAPTIVE COMFORT MODEL AND OVERHEATING IN EUROPE RE-THINKING THE FUTURE

Luisa Brotas, Fergus Nicol

Sir John Cass Faculty of Art, Architecture and Interior Design, London Metropolitan University



Indoor Operative Temperature in the bedroom against the Outdoor Running Mean in London for climates in 2020, 2050 and 2080.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

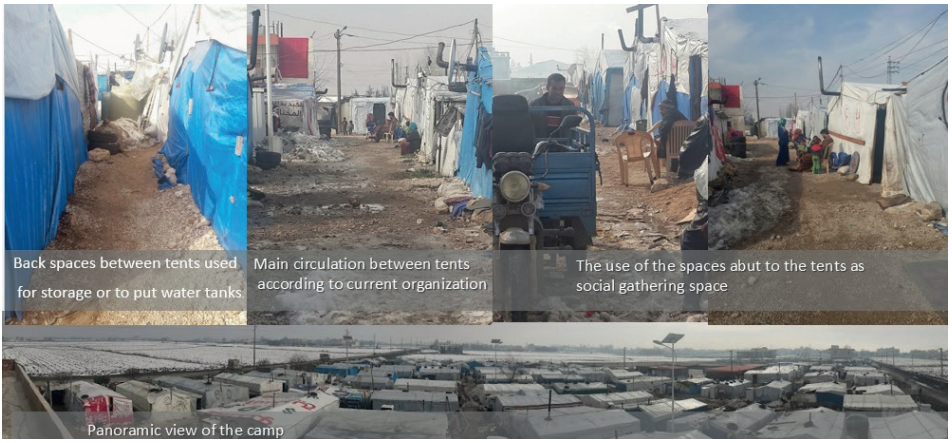
The awareness of climate change and the increasingly urgent need to reduce carbon emissions in buildings and cities is growing in parallel with concerns with the comfort of occupants due to the rising temperatures. Passive strategies for heating and cooling are first line of defence to the effects of climate change (Nicol, 2012; Roaf, 2015). Recent comfort theories have acknowledged the interaction between people and their surrounding environment. Regulations, Standards and Guidelines are good references to access and quantify the impact of changes in buildings. In Europe, EN 15251 (BSI, 2007) has suggested the methodology to look at thermal comfort in naturally ventilated buildings using the Adaptive Comfort approach. More recently CIBSE Technical Memorandum (TM) 52 (2013) has provided the criteria to look at overheating in buildings. While more real data is still needed to validate these models, recent developments in dynamic building simulation software give an opportunity to test future scenarios. This paper looks at the criteria from TM 52 and tests them on a typical archetype located in a set of cities in Europe. Because the climate is changing predictions of the energy performance and thermal comfort are assessed for morphed climates for the year 2020, 2050 and 2080. This has a major impact in the environmental, economic and social interaction of people and buildings. It will also contribute towards an assessment of the tools already available while re-thinking the way we will tackle climate change in the future.

KEYWORDS: *Overheating, climate change, adaptive comfort.*

ACCLIMATIZATION MEASURES FOR TEMPORARY REFUGEE SHELTERS IN HOT ARID CLIMATES; LOW-TECH MOBILE SOLUTIONS USING BEDOUIN TENTS

Marwa Dabaieh
Lund University

Ahmad Borham
American University in Cairo



Collage images for Tolyane refugee camp in Lebanon one of the case studies.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

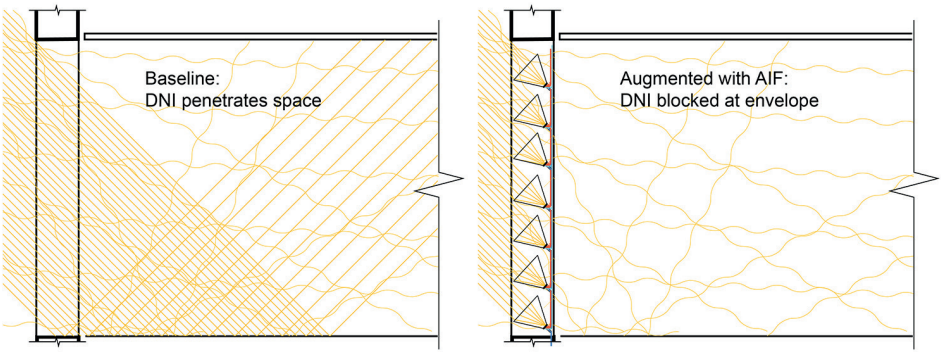
Global climate change has enormous impacts on urban areas in the developing world. The known and growing effects of climate change, like increased temperatures and increased incidence of severe storms, is evident. This winter, 2015, extreme cold waves and snow storms hit the Middle East region. Death rates in Syrian refugee camps were significant due to inefficient temporary shelters. Children and seniors were typically the most vulnerable. Additionally, the urban structures did not consider social needs and cultural behaviors. This paper investigates current social and environmental problems within Syrian refugee camps in Jordan, Egypt and Lebanon. The paper offers an analysis of Bedouin communities in the Middle East for possible use of Bedouin tents structures and clustering as a resilient solution for housing and shelter. The aim of this study is to understand the environmental behavior of the Bedouin tent structure together with socio-cultural implications among the Bedouin community. The paper applied an investigative and analytical approach using qualitative site survey methods. It concludes by defining thermal comfort adaptation measures and social clustering adopted by local Bedouin inhabitants inside their tents and draws an applicable and hands-on proposal for using such adaptation measures in current low-tech emergency shelters, especially for low-income refugees.

KEYWORDS: *Temporary refugee shelters, low-tech, energy efficiency, socio-cultural, Bedouin tent*

DAYLIGHTING EFFECT OF SEPARATING DIRECT AND DIFFUSE INSOLATION WITH FACADE-INTEGRATED, TRANSPARENT SOLAR COLLECTOR

Mohamed Aly Etman, Nick Novelli, Justin Schultz, Kenton Phillips, Brandon Andow, Anna Dyson

Rensselaer Polytechnic Institute



Daylighting of indoor spaces can be improved by an active integrated facade that blocks solar energy's direct normal component while remaining transparent to diffuse light and views.

WHICH ARE YOUR ARCHITECTURAL (R)SOLUTIONS TO THE SOCIAL, ENVIRONMENTAL AND ECONOMIC CHALLENGES OF TODAY?

Research Summary

According to the U.S. DOE Buildings Energy Data Book (2010), the building sector is responsible for 40% of the nation's primary energy consumption. 73% of US electricity went towards lighting buildings and powering their mechanical systems, resulting in 2.3 billion metric tons of CO2 emissions or 6% of global CO2 emissions. In order for the building sector to reach projected targets for clean on-site energy self-sufficiency, building envelope systems could adaptively respond to local climatic energy sources, providing simultaneous benefits such as temperature control, energy reduction, electrical generation and daylighting. Americans on average spent 90 percent of their time indoors (US EPA 1989), signifying lighting levels and glare as important factors in the comfort and desirability of built environments. Even though business hours generally coincide with available day light, in commercial buildings daylighting is under-utilized as it often results in uncomfortable glare and increases cooling demands. These two undesirable factors are largely due to the coincidence of useful diffuse insolation with less-useful direct-beam insolation, which is uni-directional, continuously shifting, and disproportionately powerful. This paper investigates an active integrated facade (AIF) that intercepts direct beam insolation while allowing for diffuse lighting to pass indoors. Using Radiance software (through DIVA), an office space employing the solar collector is compared to a baseline case. The results show that the over-lit and glare conditions decrease (improve) in the facade-collecting scenario relative to the baseline scenario, indicating the usefulness of treating diffuse and direct insolation distinctly at the building envelope.

KEYWORDS: *Building-integrated, Solar, Daylighting, Concentrating, Simulation.*

Abreu-Harbich Loyde	loydeabreu@gmail.com
Adaji Michael	mua2@kent.ac.uk
Adams Steffanie	sadams@georgebrown.ca
Afroz Ruksana	ruksana.afroz@yahoo.com
Aguacil Moreno Sergi	sergi.aguacil@epfl.ch
Agurto Leonardo	leonardoagurto@gmail.com
Ahimbisibwe Achilles	aahimbisibwe@yahoo.com
Ahmed Fahmid	fahmid.ahmed@adelaide.edu.au
Ahsan Mujtaba	ar.mujtaba.ahsan@gmail.com
Aimilios Michael	aimilios@ucy.ac.cy
Al-Kurdi Feryal	fkurdi@uod.edu.sa
Al-Maiyah Sura	sura.almaiyah@port.ac.uk
Ali Alghamdi Sarah	sarahalghamdi@yahoo.com
Alimi Mehregan	mehr.alimi@gmail.com
Alonge Fernanda Aparecida	fer.alonge@gmail.com
Alonso Frank Alción De Las Pléyades	afrank@faud.unsj.edu.ar
Aly Mohamed	mohamed.aly@aucegypt.edu
Andone Alexandra	alexandra.andone.aa@gmail.com
Aparecida Alonge Fernanda	fer.alonge@gmail.com
Attea Paul	paulattea89@gmail.com
Baderia Nishita	nishita_baderia@infosys.com
Bahho Mazin	mazinis@eit.ac.nz
Bajramovic Bruna	bruna.baj@gmail.com
Barbosa Sabrina	s.barbosa@brighton.ac.uk
Barth Fernando	fernando.barth@ufsc.br
Battistella Alessio	a.battistella@ar-co.org
Ben Dayan Meital	meitalbendayan@gmail.com
Bender Lívia	liviabender@hotmail.com
Berta Mauro	mauro.berta@polito.it
Bisiaux Marion	marion.bisiaux@lesgrandsateliers.fr
Bothwell Keith	kba@gn.apc.org
Bournas Iason	jasbour@gmail.com
Bregiatto de Oliveira Paula	paula.bregiatto@gmail.com
Brotas Luisa	l.brotas@londonmet.ac.uk
Brown G.Z.	gzbrown@uoregon.edu
Brunetti Gian Luca	gianluca.brunetti@polimi.it
Bustamante Waldo	wbustamante@uc.cl
Bustos Romero Marta Adriana	alineccnemer@gmail.com
Caneparo Luca	luca.caneparo@polito.it
Cariolet Jean-Marie	jean-marie.cariolet@eivp-paris.fr
Cascone Paolo	paolo@co-design-lab.net
Castillejo-Celigueta Ana	acastill2@alumni.unav.es
Chatzidimitriou Angeliki	ange1iki@arch.auth.gr
Chatzipoulka Christina	c.chatzipoulka@kent.ac.uk
Chun Yang Zhang	2656463777@qq.com
Cichocka Judyta	judyta.cichocka@gmail.com
Clementella Gioia	gioia.clementella@uniroma1.it
Compagnon Raphaël	raphael.compagnon@hefr.ch
Costa Ana	cynthia.s@hotmail.com
Cremers Jan	jan.cremers@hft-stuttgart.de
Cuerda Elena	e.cuerda@upm.es
Cuvellier Simon	simon.cuvellier@uclouvain.be
D'Angelo Carolina	carolina.dangelo@hotmail.it

Dabaieh Marwa	marwa.dabaieh@arkitektur.lth.se
Dartevelle Olivier	olivier.dartevelle@uclouvain.be
Das Sutapa	sutapa.d@gmail.com
De Schiller Silvia	sdeschiller@gmail.com
Debnath Kumar Biswajit	kumar.biswajit@gmail.com
Dessì Valentina	valentina.dessi@polimi.it
Diaz Muriel	madiazc@ubiobio.cl
Diaz Camilo	camilo.diaz@wspgroup.com
Din Asif	asifdin@hotmail.com
Drori Daphna	daphna.drori@gmail.com
Du Xiaoyu	x.du@tudelft.nl
Efeoma Meshack	mefeoma@gmail.com
El-Deeb Khaled	Km_eldeeb@yahoo.com
Elfiky Usama	u.elfiky@eng.kfs.edu.eg
Elías López Pablo	gmzmdr@gmail.com
Engelhardt Martin	engelhardt@transsolar.com
Erell Evyatar	erell@bgu.ac.il
Escandón Rocío	rescandon@us.es
Evans John Martin	evansjmartin@gmail.com
Evrard Arnaud	arnaud.evrard@uclouvain.be
Feifer Lone	lone.feifer@velux.com
Femenias Paula	femenias@chalmers.se
Ferreira Ana	arq.anaferreira@gmail.com
Finocchiaro Luca	luca.finocchiaro@ntnu.no
Fleenor Kelsey	kfleenor@iastate.edu
Ford Brian	brian@naturalcooling.co.uk
Gallo Paola	paola.gallo@unifi.it
Gálvez Miguel Angel	nina.hormazabal@gmail.com
Garcia-Nevado Elena	elena.garcia.nevado@upc.edu
Gaztelu Onaindia Ugaitz	ugaztelu@gmail.com
Ghabra Noura	noura.ghabra@gmail.com
Ghisi Enedir	lai_almeida@hotmail.com
Gillott Mark	laxvs4@nottingham.ac.uk
Gomaa Bakr	B.gomaa@aast.edu
Gomez-Amador Adolfo	josefrancisco.armendariz@gmail.com
Gooljar Yogeshwar	yogesh@pjc.co.za
Goyette Pernot Joelle	joelle.goyette@hefr.ch
Guerra-Santin Olivia	o.guerrasantin@tudelft.nl
Gupta Rajat	rgupta@brookes.ac.uk
Hatefnia Navid	navidhatefnia@gmail.com
Heracleous Chryso	chryso.heracleous@bath.edu
Hii Daniel Jun Chung	dhjc@nus.edu.sg
Hossain Md Mohataz	mdmohataz.hossain@nottingham.ac.uk
Hossain Labib	labib@arch.buet.ac.bd
Huang Qiong	qhuang@tju.edu.cn
Huang Zujian	arymsun@scut.edu.cn
Ilia Polytimi	politimi_ilia@yahoo.gr
Infante Alcalde Josefina	jinfant4@uc.cl
Inoue Takashi	yfa01201@nifty.com
Invidiata Andrea	a.invidiata@gmail.com
Iorwerth Heledd	iorwerthh@cardiff.ac.uk
Islam Saiful	saif_1509@yahoo.com
Iwamoto Gabriel	gabriel.iwamoto@gmail.com

Jamei Elmira	ejamei@deakin.edu.au
Javed Shamim	javeds@vt.edu
Joarder Md Ashikur Rahman	ashikj2000@gmail.com
Kanisetti Venkatesh	rballhar92@gmail.com
Karabašević Anđela	andjela.karabasevic@gmail.com
Kawai Hidenori	kawai.h.ac@m.titech.ac.jp
Kayo Genku	genku.kayo@aalto.fi
Kenawy Inji	inji.kenawy@bue.edu.eg
Kent Michael	michaelgeorgekent@gmail.com
Khalfan May	m.khalfan@liverpool.ac.uk
Kiamba Lorna	laxlk2@nottingham.ac.uk
Kindangen Jefrey	jkindangen@yahoo.com
Kiss Ida	kiss.ida@abud.hu
Kodama Yuichiro	y-kodama@kobe-du.ac.jp
Kumakura Eiko	kumakura@tmu.ac.jp
Kuriki Tatsuya	k_Ob96@yahoo.co.jp
La Roche Pablo	pmlaroche@csupomona.edu
Labaki Lucila	dripasc@uol.com.br
Labib Rania	rlabib@tamu.edu
Lang Werner	w.lang@tum.de
Laprise Martine	martine.laprise@epfl.ch
Larsen Olga	Olga.larsen@kadk.dk
Lasrindy Nadia	nadiavashti@gmail.com
Lau Kevin Ka-Lun	kevinlau@cuhk.edu.hk
Leaf Julian	leafj@post.bgu.ac.il
Lee Hyunjung	hyunjung.lee@meteo.uni-freiburg.de
Li Jing	archedward@hotmail.com
Lima Fernando	fernandolima3d@gmail.com
Liuke Laura	laura.liuke@hdm.lth.se
Lopez De Asiain Jaime	mlasiain@gmail.com
López De Asiain Alberich María	bcano@cthabitec.com
Lumbreras Maria	ariam_lumbreras@hotmail.com
Mahgoub Mohamed	melnabawi@aucegypt.edu
Malaktou Eleni	meleni@ucy.ac.cy
Malekafzali Ahoo	amaleka2@ncsu.edu
Manu Sanyogita	Sanyogitamanu@cept.ac.in
Marchionni Chiara	chiara.marchionni@graduate.univaq.it
Marconcini Sebastiano	sebastiano.marconcini88@gmail.com
Marcondes Cavaleri Monica	mopm2@terra.com.br
Mardas Byron	byron.mardas@aaschool.ac.uk
Martin Benjamin	benjamin.martin@holscot.com
Masiero Érico	ericomasiero@yahoo.com.br
Matheus Carla	matheuscarla@hotmail.com
Maturana Beatriz	maturana@uchilefau.cl
Medeiros Jose	medeirosjose@gmail.com
Mestoul Djamel	d.mestoul@epau-alger.edu.dz
Micallef Daniel	daniel.micallef@um.edu.mt
Mingozzi Angelo	mingozzi@ricercaeprogetto.it
Miramontes Gaspar Dulce Maria	dulce_miramontes@yahoo.com.mx
Miyamoto Ayu	ayu.miyamoto@student.kuleuven.be
Mlecnik Erwin	e.mlecnik@tudelft.nl
Mohd Ariffin Ati Rosemary	shipah79@gmail.com
Moletto Alberto	Amoletto@gmail.com

Morelli Denise D.o.	denise_d@uol.com.br
Moreno Rangel Alejandro	alexandros822@gmail.com
Morganti Michele	michele.morganti@uniroma1.it
Munari Probst Mariacristina	mariacristina.munariprobst@epfl.ch
Nagargoje Shekhar	snagargoje@nicmar.ac.in
Namburu Hara Kumar Varma	nhkvarma.archi@gmail.com
Nanaiah Megha	meg.nanaiah@gmail.com
Naoum Fiona	fionana3oum@hotmail.com
Naseem Yasir	yasirnaseem1@outlook.com
Nault Emilie	parag.rastogi@epfl.ch
Nazer Heba	nazerheba@gmail.com
Nikolakea Iro	iro@nikolakea.gr
Ojeda Sánchez Jorge Armando	carlos.javier.esparza.lopez@gmail.com
Oliveira Rui	mfrodrigues@ua.pt
Ortiz Alberto	aortizras@hotmail.com
Paek Jeewon	jeewon.paek@henn.com
Pak Naghmeh	melodypak@ymail.com
Palla Nansi	nansi.palla@hft-stuttgart.de
Palme Massimo	mpalme@ucn.cl
Pamfili Mileni	milenipamf@gmail.com
Paneru Suraj	s.paneru@rgu.ac.uk
Paolini Federica	federica.paolini@uniroma1.it
Parveen Rehnuma	rehnuma.parveen@adelaide.edu.au
Pasetti Monizza Gabriele	Gabriele.Monizza@natec.unibz.it
Patel Chinmay	pcchinmay@gmail.com
Patidar Shikha	patidar.vinyas@gmail.com
Peronato Giuseppe	giuseppe.peronato@epfl.ch
Picción Alicia	magdalenacr@gmail.com
Pierson Clotilde	clotilde.pierson@uclouvain.be
Pikle Sheetal	sheetalpikle@gmail.com
Pollo Riccardo	riccardo.pollo@polito.it
Pottgiesser Uta	uta.pottgiesser@hs-owl.de
Pradeep Shravan	shravanpradeep@gmail.com
Prenna Enrico	enrico.prenna@unicam.it
Prozuments Aleksejs	aleksejs.prozuments@rtu.lv
Qobrosi Rawan	rawan.qubrosi@gmail.com
Raimondi Alberto	alberto.raimondi@uniroma3.it
Rajapaksha Upendra	rajapaksha_upendra@yahoo.com
Resente Valentina	valentina.resente@studioazue.eu
Rey Emmanuel	emmanuel.rey@epfl.ch
Riera Pérez Maria Gracia	mariagracia.riera@epfl.ch
Roberti Francesca	francesca.roberti@eurac.edu
Rocco Luca	ulheine@clemson.edu
Rodrigues Lucelia	cristinavmc@gmail.com
Rogora Alessandro	alessandro.rogora@polimi.it
Romano Scarlet	scarlet.arq@gmail.com
Romano Rosa	arch.rosaromano@gmail.com
Rossi Monica	monica.rossi@htwk-leipzig.de
Rossi Andrea	andrearossi.jmy@gmail.com
Ruegemer Joerg	ruegemer@arch.utah.edu
Saavedra Leopoldo	leopoldo.saavedra@tum.de
Sacht Helenice Maria	nicesacht@yahoo.com.br
Saha Suparna	ar.suparna.saha@gmail.com

Salvati Agnese	agnese.salvati@uniroma1.it
San Miguel Jorge	jsan@alumni.unav.es
Sanathkumar Pavitra	pavitra.sanath@gmail.com
Sangtani Choudhary Rashmei	rashmei.sangtani@gmail.com
Santucci Daniele	daniele.santucci@lrz.tum.de
Sartori Ziebell Clarissa	clarissa.ziebell@ufrgs.br
Sassi Paola	psassi@brookes.ac.uk
Sattayakorn Sutida	porpla@hotmail.co.uk
Scattolini Elena	elenaesse@yahoo.it
Schiano-Phan Rosa	r.schianophan@westminster.ac.uk
Schiler Marc	gbecker@usc.edu
Schmidt Eric	ejr.schmidt@gmail.com
Schneider Patricia	patricia.schneider@tum.de
Scofone Amedeo	amedeo.scofone@gmail.com
Sharpe Tim	t.sharpe@gsa.ac.uk
Sheta Wael	waelsheta@gmail.com
Shih Wen-Mei	rlhwang6202@gmail.com
Shukuya Masanori	shukuya@tcu.ac.jp
Sirichanchuen Praew	king_red_devil@hotmail.com
Sirombo Elisa	elisa.sirombo@polito.it
Sirsi Mitakshi	mitakshi.sirsi.13@ucl.ac.uk
Somuncu Yasemin	yaseminsomuncu@gmail.com
Spiegelhalter Thomas	tspiege@fiu.edu
Stasinopoulos Thanos	delaxo@gmail.com
Sugawara Masanori	msugawa@staff.miyakyo-u.ac.jp
Summers Francoise	fsummers@metu.edu.tr
Sun Mingwei	meanwhilesun@hotmail.com
Sun Yizhao	syzlavender@hotmail.com
Surahman Usep	u_surahman@yahoo.com
Szalay Zsuzsa	zsuzsa.szalay@yahoo.com
Tachouali Dania	201311712O@student.buid.ac.ae
Tan Zheng	tanya@link.cuhk.edu.hk
Terrés Guillermo	guillermo_terres@hotmail.com
Thitisawat Mate	mthitisa@fau.edu
Thoua Chryssa	chryssa.thoua@gmail.com
Thuvander Liane	liane.thuvander@chalmers.se
Timusk P. Christopher	ctimusk@georgebrown.ca
Tokumura Tomoko	tokumura.tomoko@takenaka.co.jp
Tonelli Chiara	chiara.tonelli@uniroma3.it
Tóth Réka	toth.reka@abud.hu
Touloupaki Eleftheria	lillytoul@gmail.com
Trebilcock Maureen	mtrebilc@ubiobio.cl
Troncoso Lorena	lorena618@gmail.com
Trigaux Damien	damien.trigaux@asro.kuleuven.be
Tsang Steven	steven.tsang@cuhk.edu.hk
Tsichritzis Leonidas	leotsixri@gmail.com
Tsikaloudaki Katerina	katgt@civil.auth.gr
Tumini Irina	irina.tumini@gmail.com
Utzinger Michael	utzinger@uwm.edu
Valencia Morales Maria Victoria	victoriavalencia@pvgarquitectos.com
Vallejo Juan	juanan.v@naturalcooling.co.uk
Van Moeseke Geoffrey	geoffrey.vanmoeseke@uclouvain.be
Vasilikou Carolina	kv50@kent.ac.uk

Vásquez Zaldívar Claudio	clvasque@uc.cl
Vellei Marika	M.Vellei@bath.ac.uk
Venancio Raoni	raoni_vsl@yahoo.com.br
Vianna Saionara	svianna75@hotmail.com
Victorero Felipe	favictor@uc.cl
Wagdi Dalia	daliamohamed@aucegypt.edu
Walsh Angélica	angewalsh7@hotmail.com
Wang Yupeng	wang-yupeng@outlook.com
Wang Meinan	13969800348@163.com
Watkins Richard	R.Watkins@kent.ac.uk
Weber Filippo	filippo@filippoweber.com
Wegertseder Paulina	p.wegertseder.m@gmail.com
Weisel Astrid	astrid.weisel@hs-augsburg.de
White Jennifer	j.white@nottingham.ac.uk
Whitman Christopher	whitmancj@cardiff.ac.uk
Widera Barbara	barbara.widera@pwr.edu.pl
Wong James Pow Chew	james.wong@rmit.edu.au
Yang Feng	yangfeng@tongji.edu.cn
Yezioro Abraham	ayez@ar.technion.ac.il
Zapata-Lancaster Gabriela	zapatag@cardiff.ac.uk
Zhang Ji	hope.zh@gmail.com
Zhang Anxiao	zhanganxiao@tju.edu.cn
Zhao Jing	s0945004@sms.ed.ac.uk
Zhu Wei	the.weizhu@gmail.com
Zrim Grega	grega.zrim@siol.net

SUSTAINABLE ARCHITECTURE + URBAN DESIGN